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Video Simulation for Training Land Design for Realism

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Guidelines for Applying Video Simulation Technology to Training Land Design

by
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FOREWORD

This research was performed for the U.S. Army Engineering Housing and Support Center (USAEHSC), Fort Belvoir, VA, under Project 4A162720A896, "Base Facility Environmental Quality"; Work Unit NN-TW2, "Video Simulation for Training Land Design for Realism." The technical monitor was Dr. Victor Diersing, CEHSC-FN.

This study was performed by the Environmental Resources Division (EN) of the Environmental Sustainment Laboratory (EL), U.S. Army Construction Engineering Research Laboratories (USACERL). The USACERL principal investigator was Richard M. Marlatt, and the associate investigator was Thomas A. Hale. Part of the work was performed by R.G. Sullivan, of Argonne National Laboratory, Argonne, IL, under Military Inter-Departmental Purchase Request (MIPR) No. 92-059. Dr. William D. Severinghaus is Acting Chief, CECER-EN, and William D. Goran is Acting Chief, CECER-EL. The USACERL technical editor was William J. Wolfe, Information Management Office.

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GUIDELINES FOR APPLYING VIDEO SIMULATION TECHNOLOGY TO TRAINING LAND DESIGN

1 INTRODUCTION

Background

Two important aspects of Army training land design and management are to provide a suitable training experience for Army units and to minimize environmental damage from training activities. Training area land managers must balance training needs with environmental concerns to provide realistic, feasible training while minimizing environmental impacts. Achieving this balance requires a thorough understanding of training needs and the ability to incorporate reliable input from trainers and other experts into the training area design and management process. Furthermore, as public awareness and concern for Army land use practices increases, training area land managers must be able to clearly communicate their design and management goals to the public in a format easily understood by nontechnical persons (Marlatt, Hale, and Sullivan 1992).

Considering the many different parties involved in training land design and management issues, each with different (sometimes competing) objectives and priorities, it becomes vital for related issues to be aired clearly. For example, if trainers, decisionmakers, or the public do not understand the impacts of proposed land management actions, they may not cooperate with the land managers, and may impede the land management process. Land managers and engineers, in turn, must be able to communicate effectively with Army trainers. Land managers must understand training needs and the ways in which land management actions affect the environment so they can structure their activities to minimize environmental damage. The engineers who will build structures that support both training and environmental needs must be able to convey technical issues to both trainers and land managers. Better communication between these groups would foster the cooperation necessary to manage training lands effectively for both environmental quality and maximum training realism.

Video technology can fill many of the needed communication goals: it can communicate technical information visually, in a simple, engaging form that is easy for both technical and nontechnical persons to understand. Research on incorporating video simulation into training land design was initiated in 1989 as part of the Integrated Training Area Management (ITAM) program. The ITAM program, developed at the U.S. Army Construction Engineering Research Laboratories (USACERL), consists of three components: (1) Environmental Awareness, (2) Land Rehabilitation and Maintenance, and (3) Training Requirements Integration.

Under the ITAM program, USACERL has developed a three-phase research implementation approach for video simulation (Appendix A). The first phase is an application demonstration performed by USACERL researchers to show various installations how the technology might be applied to their land management activities. During the second phase, the installation determines whether it would like to acquire in-house capability for video simulation, based on the results of the first phase. A third phase provides additional training support as needed by the installation.

Applications of video technology, currently under review at several installations, have indicated a need for a clear "how to" manual and reference designed to help Army land managers and trainers to better apply video simulation technology to their land management activities.

Objective

The objective of this study was to provide a general overview of the use of video simulation technology for use by Army training land managers, natural resources personnel, and trainers, including: (1) a description of the hardware and software components of the workstation, (2) a summary of general procedures for producing simulations, including image input, editing and output, (3) a brief description of the operating procedures for the major hardware and software components, and (4) tips and strategies for producing high-quality visual simulations.

Approach

The information in this report is a compilation and expansion of much prior research and experience. A literature search of information regarding current video technology was done to gather the general, technical, and conceptual information on video simulation (Chapters 2 and 4). A market study of currently available hardware and software provided the basis for descriptions of hardware and software systems, and their operation (Chapters 3, 5, and 6).

Scope

Information in this report is based on initial evaluations of applications at Fort Knox, KY, Fort Sill, OK, Fort McCoy, WI, Fort Huachuca, AZ, Camp Shelby, MS, and the Seventh Army Training Command and V Corps in Germany, but is not site-specific. This information may be used to form the basis for a video simulation program at any military installation.

Mode of Technology Transfer

It is recommended that information from this study be incorporated into a Department of Army Technical Bulletin.

2 VIDEO SIMULATION: AN OVERVIEW

Graphic Communications Tool

A video simulation workstation is a system of computer hardware and software designed to produce realistic simulations of potential visual impacts resulting from Army training land management actions. The visual simulations produced by a video simulation workstation can be used to communicate impacts to various audiences, such as Army trainers, decisionmakers, or the public, and can serve as a basis for discussing land management planning and design. In this sense, the video simulation workstation can be thought of as a graphic communications tool.

Video simulations are photographic images that closely resemble the actual appearance of the landscape after the land management action has been implemented (assuming proper care and maintenance after implementation). Simulations can usually be produced in less than 1 day, sometimes in as little as 1 hour. Simulations can be output in a variety of formats, such as 35mm slides, hardcopy prints, overheads, and VHS videotapes, thus providing several choices for presentation format.

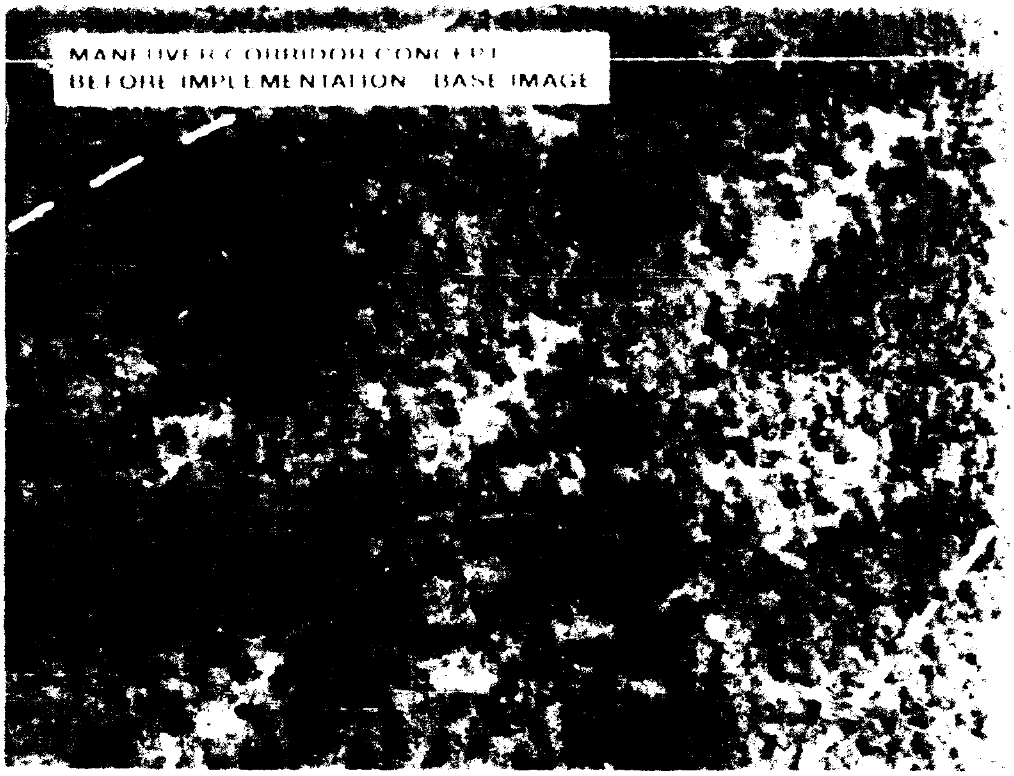
In addition to its primary use in producing visual simulations, the video workstation has several secondary uses; it can be used to produce high-quality text and sketch graphics for use in briefings or presentations; it can be used to add labels, descriptive text, and sketch graphics to still images or live video, or to create photo-montages for use in communicating land management information; it can be used to capture or "freeze" images from videotape and output these images as slides, prints or overheads, etc; and it can produce video "slide-shows" consisting of sequences of still images, with or without the addition of live video segments.

Applications

Video simulation technology was recently applied at Camp Shelby, MS to show decisionmakers and the public the potential impacts of several proposed training land use changes (R. Marvin Marlatt and Thomas A. Hale, "Helping Environmental Decisionmakers Through Video Imaging," *Army RD&A Bulletin* [May-June 1992], pp 1-3). Communication among several individuals with different backgrounds and responsibilities was crucial to development of an environmental impact statement for the proposed changes. At all stages in the simulation process, Camp Shelby project planners were able to provide feedback to the image editor as the simulations were created (Figure 1). This iterative process helped both the planners and decisionmakers to ensure that design intentions were clearly understood (R.M. Marlatt, T.A. Hale, and R.G. Sullivan, "Video Simulations as Part of Army Environmental Decision-Making: Observations from Camp Shelby, Mississippi," *Environmental Impact Assessment Review* [In Press]).

The Camp Shelby experience with video simulations as aids to decisionmaking demonstrates one very important advantage of the technology: the ability to quickly and easily incorporate changes into the design process. This feature encourages participation because suggested changes can be viewed immediately after the image is edited.

Video simulation for training land management has also been applied at Fort Riley, KS. Land managers wished to erect some type of vehicle barriers around trees within the training area to protect them from damage (Figure 2). The training community was skeptical about the idea. A series of video simulations illustrating the concept from the land manager's perspective was prepared and shown to the trainers for their comments. Rather than rejecting the concept, the trainers provided constructive comments and became involved in the design process. Again, video simulation showed itself as a



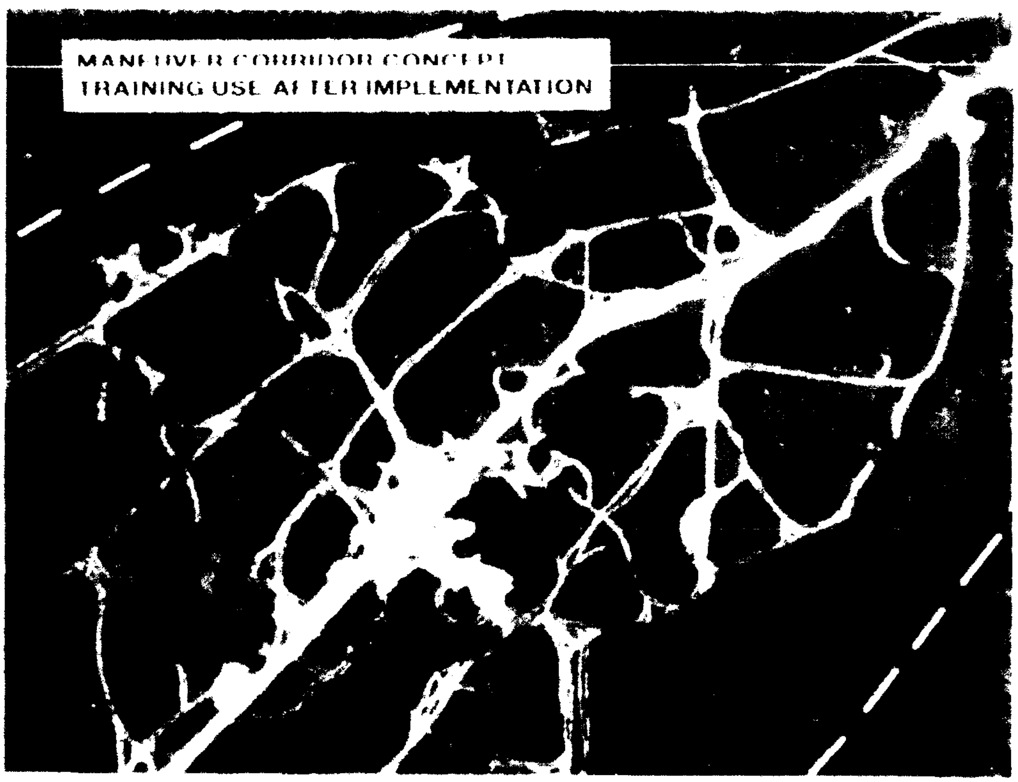


Figure 1. Camp Shelby Video Simulation (Proposed Maneuver Corridor).

Figure 2. Fort Riley Video Simulations (Vehicle Barriers).

convenient communication/coordination tool that helped accomplish a training mission with respect to environmental considerations.

Fort Sill recently acquired the in-house capability to produce video simulations, and has been using them to design hardened firing points, among other things. Such simulations have been useful in gaining consensus and approval for various land management activities.

In addition, video simulation application demonstrations have been conducted at Seventh Army Training Command and V Corps in Germany, Fort Huachuca, Fort McCoy, Fort Knox, and Fort Jackson. In all cases, the goal is to increase communication and coordination among the installation land managers and trainers.

General Process For Simulation Preparation

The general process of producing video simulations occurs in four steps (see Figure 3):

1. Photographs or video images of existing training area landscapes are converted into a digital format (digitized) and stored in the computer as an image file.

2. The image files are then edited or retouched to produce images that resemble the appearance of the landscape after a land management action has been implemented.

3. These edited images may then be output in a variety of different formats including 35mm slides, videotape, and color prints and transparencies.

4. This output can then be presented to various audiences to provide information for decisionmaking and feedback purposes.

The simulation production process can be broken down into four major components:

1. **Image capture** includes assessing the simulation needs for the project and then capturing the appropriate base and library images in the field photographically using either 35mm slide photography or videography.

2. **Image input** describes the process of converting captured images into a digital format and storing them as computer files. The image file format used by the system is the TARGA or TGA format developed by Truevision, Inc. This file format is an industry standard compatible with the various software applications used by the system. This means that TGA files created in one application can be imported and used by all the other compatible applications.

3. **Image editing and layout** consists of using workstation software for editing or retouching the digitized base images to produce finished video simulations. These images are also in digital form, which necessitates the next step—output.

4. **Image output** is the process of transferring base images, finished simulations, and any other TGA images, to 35mm slides, hardcopy prints, overheads, videotape, etc.

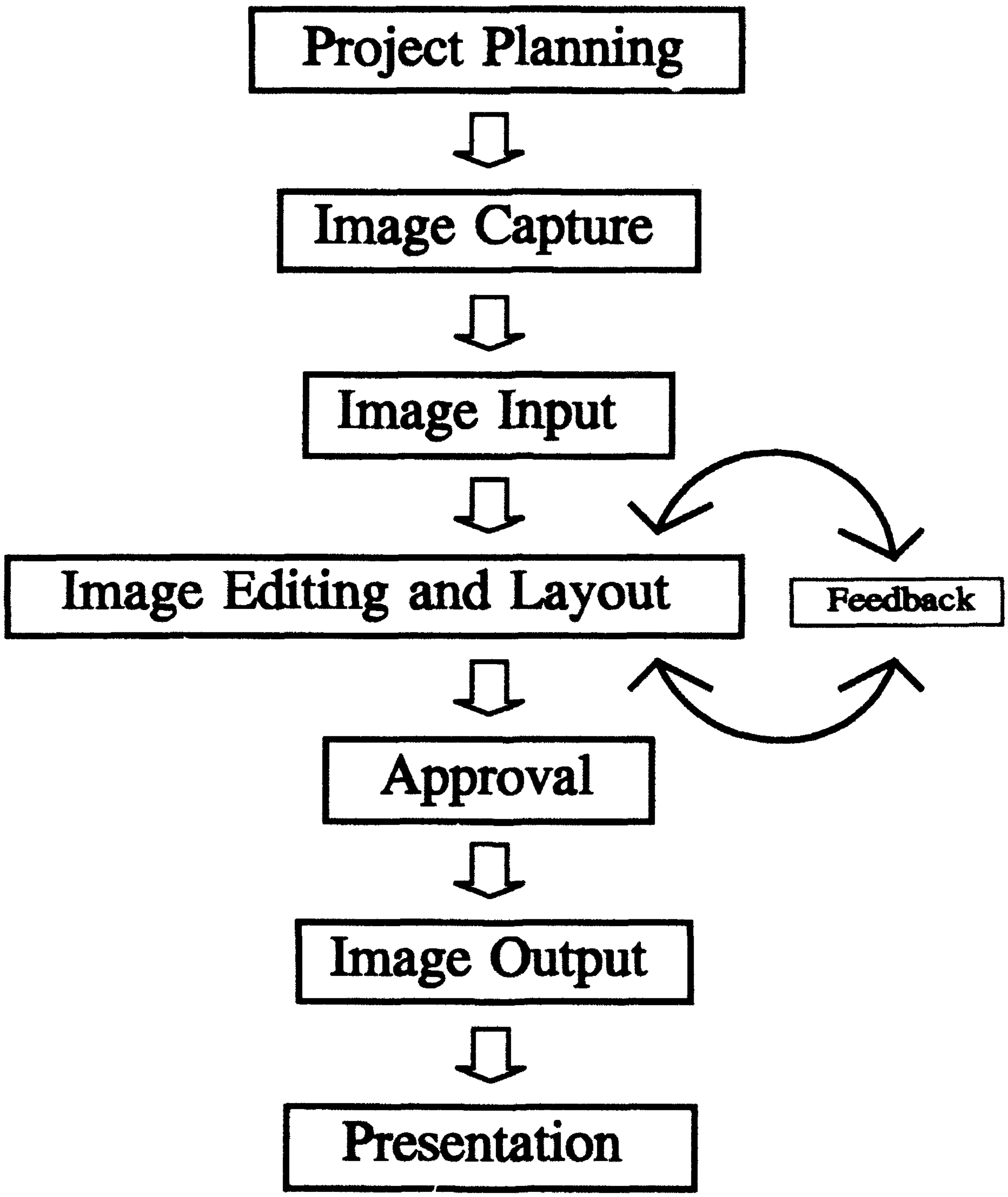


Figure 3. Simulation Process Flow Diagram.

3 SYSTEM COMPONENTS AND OPERATION BASICS

Workstation Configuration

This chapter details the configuration of the video simulation workstation with regards to computer hardware, software applications, and setup issues. The mention of specific manufacturers or specific hardware and software components is not to be taken as a recommendation.

Hardware Components

Central Processing Unit (CPU). Provides data processing, image and data file storage, holds expansion cards, provides device interfaces.

Videographics Adapter. Provides image input, output, and processing capabilities. The videographics adapter is the most important hardware component of the video simulation workstation. The videographics adapter is the device that allows display and manipulation of high-resolution, full-color images, as well as direct input and output of video signals for image capture and videotape recording. This videographics adapter is manufactured by Truevision, Inc. and is called the TARGA+. This particular adapter is an industry standard and is located in one of the expansion slots inside the CPU. The TARGA+ can be programmed to display images at a variety of spatial resolutions and color depths, providing a high degree of flexibility in image display and output quality.

VGA Monitor. Displays information for the system and software applications on the Disk Operating System (DOS) command line and also displays the menu interface for the system. The VGA monitor in the simulation workstation serves primarily as a "dumb terminal" in the sense that it is not used to display simulation images. It is used to display menus, commands, and system information for some of the imaging software as well as the disk operating system (DOS). It may also serve as the main display for unrelated software that may be installed on the simulation workstation (e.g., word processors).

RGB (Red-Green-Blue) Analog Multisync Monitor. Displays digitized images for input, editing and output purposes. The RGB analog monitor allows the display of TGA format graphic files, and is the main "working" monitor for the simulation workstation. The analog monitor is directly connected to the TARGA+ board, and accepts separate red, green, blue and sync analog signals from the board. The signal from the TARGA+ board is not digital, so the analog monitor is fundamentally different from the VGA monitor in several respects, the most important being that it can simultaneously display millions of colors, while the VGA monitor can simultaneously display only 256 colors. The analog monitor is neither a video monitor nor a television. It cannot be used to display output from a standard VCR or commercial television stations.

35mm Slide Scanner. Digitizes 35mm slide or negative images into a TGA graphics file format. The scanner is used to input images when image quality is of primary importance. In most cases it is capable of producing much better images than can be captured from videotape. It can scan (digitize) either 35mm slides (positives) or film negatives at high resolution, and write them directly to the TGA graphic file format used by the imaging software. The scanner interfaces with the system via an IEEE GPIB controller, which is an expansion card installed in the CPU. The software driver for the scanner is found in the RIO software package.

Postscript Thermal Transfer Printer. Produces high-quality color hardcopy prints and overheads. The color postscript printer outputs hardcopy prints at resolutions up to 300 dots per inch (DPI). It is connected to the CPU through a parallel port and controlled by a postscript driver accessed through the RIO software application, discussed below.

Mouse or Digitizing Tablet. These software control devices are used as input devices for the video software packages instead of the keyboard. These hand-held devices provide a more intuitive, natural feel for graphics work (which is essentially artistic in nature). The mouse is a two-button controller that uses a tracking ball to move the cursor on screen. The digitizing tablet is similar in function to a mouse. It can be used with either a four-button puck or a stylus. Since the stylus is similar in form and feel to a pen or artist's brush, simulation preparers may find the stylus preferable to the puck.

Image Capture Devices (35mm Camera, Video Camera). Sources of base images for simulations. A 35mm camera is necessary to provide slides or film negatives for scanning. A 28 to 80mm variable focal length zoom lens is recommended, but a 50mm fixed focal length lens will be adequate for most simulations. Extreme wide-angle or telephoto lenses should be avoided. Any VHS video camera will suffice, but a zoom function may be useful for framing purposes.

Video Cassette Recorder (VCR). Image output device, also source of base images for simulations. A VCR is used both as a source for base images that can be captured directly by the TARGA+ board and as a destination for images output from the TARGA+ board. Video output is usually in the form of "slide shows" composed using the Panorama software discussed below. If a unit is to be purchased for use with a simulation workstation, desirable features include multiple video inputs and outputs using BNC connections, and a remote control.

Software Components

Software components provide control of input and output devices, editing functions, and "slide show" composition.

Disk Operating System - (DOS). DOS is a command line driven operating system that manages the flow of information to and from the various parts of the system. It manages files, directories, and disks. It also optimizes memory and configures hardware.

Expanded Memory Manager - (EMM). This software manages the extended and expanded memory that many of the video simulation applications rely on for optimum performance.

Menu Software - Menu Construction Set (MCS). MCS is a menu package that uses a batch file structure to allow easy access to the various video software packages. It also offers some basic on-line help, and selections for helpful custom functions and compression utilities. The menu screen appears when the machine is turned on, with titles and descriptions of the various packages.

Image-Editing Software—Truevision Image Processing Software (TIPS). TIPS is a painting, sketching, and editing package that is used primarily to edit images to produce simulations. TIPS is an icon-driven software package that provides simple but powerful tools for retouching images, importing graphics from other images, and adding sketch graphics to images. Although TIPS has text and labeling functions, they are not as sophisticated as those found in Resolution-Independent Object-Oriented software (RIO).

Image Layout and Vector Font Software - Resolution-Independent Object-Oriented Software (RIO). RIO performs several important functions in the process of preparing images. Scanner and printer operations are controlled through the RIO package. RIO controls the image layout; that is, it formats images for certain sizes and shapes of output, such as 35mm slide dimensions, or 8.5 x 11-in. hardcopy dimensions. RIO can also provide high-resolution vector-based text and graphics for the creation of high quality images for presentation.

Image Sequencing Software - Panorama. Panorama is used to create video "slide shows" by displaying a user-defined sequence of TGA file images created in other applications. An image is displayed for a preset length of time and then changes to the next image. The transitions include a variety of wipes and video special effects. The ability to create slide shows is very useful in making presentations. For example, a series of simulations for a particular training area can be combined into a presentation that shows images of existing landscapes changing to post-impact appearance in a few seconds. Simulation images can be combined with support graphics to create a dynamic presentation that can be recorded onto videotape if desired. Panorama allows creation of a "script" for each presentation including controls for image sequencing, duration of time to display an image, and type of video "transition" between successive images.

Basic Operations

User Interfaces

Menu Construction Set (MCS). As explained above, the menu construction set is a simple menu interface that allows the user to access software applications, receive help, perform some basic DOS functions (e.g., formatting a diskette), and custom functions. The ease of use of the MCS in relation to the more complex DOS command line recommends its use as a valuable time-saver.

MCS is structured into a run-time environment and an authoring environment. For most purposes, only the run-time environment is needed. This is invoked by typing: "menu 1" at the DOS prompt (C:\). Normally, this will load automatically when the workstation is initially turned on. The authoring-environment is used to change the existing menu structure (e.g., to add a new item) or to create a new menu set altogether. This is invoked by typing: "mcs 1" to change the existing set, or just "mcs" to create a new set. The MCS authoring environment uses batch file commands and structure in building new sets. The "Working with Batch Programs" section of the DOS User's Guide and Reference Manual is a helpful addition to this software.

Select the menu item of choice by using the arrow keys on the keyboard followed by pressing the <enter> (or <return>) key. Another method that may sometimes be faster is to type the first letter of the chosen item and then <enter>. Selecting a menu item will: (1) run a batch file, (2) cause a submenu to appear, or (3) cause an information screen to appear. The <esc> key may always be depressed to "back out" of a submenu or information screen. At the highest menu level, the <esc> key will take the user out of the menu set to the DOS command line.

Disk Operating System (DOS). The DOS command line will show a prompt that includes the current drive, directory, and sub-directory, if one exists. A typical DOS prompt may look like: C:\RIO. Basic DOS commands are all thoroughly explained in the DOS User's Guide and Reference Manual and will not be covered here. It is a good idea to learn the DOS basics to be able to efficiently perform basic file management tasks.

DOS Shell. An alternative to the DOS command line is the DOS Shell interface (available with microsoft DOS version 5.0). The shell uses color and graphics to offer a visual way of working with DOS. This is a selection available on the MCS root menu. To load the shell from the command prompt, just type: "dosshell" and press <enter>. Complete documentation on the DOS Shell can be found in the DOS User's Guide and Reference Manual.

Windows. The Microsoft Windows™ graphical user interface is not currently used in video simulation work at USACERL. The use of MS Windows as an interface for use with video simulation for Army training land design is being investigated.

File/Directory Structure and Management

Types of Files. The most common types of files seen when in the DOS environment are the "executable" or "command" program files that contain the programs that the computer runs. These files are usually named with an .EXE or .COM extension. Other common file types include system files (sometimes called device drivers) and batch files that include .SYS and .BAT extensions, respectively.

The video imaging software applications produce specialized data files that are unique to this area of technology. The use of these files and the extensions that identify them are:

1. TGA - The Targa graphics file format is an industry standard in the field of computer videographics technology. It stores the digital information necessary to recreate the original digitized photographic image or any iterative images that may have been created during the editing process. Targa files can be used by any of the other graphics packages included with the workstation.

2. WIN - The window file is a graphics file that contains a portion of a full-sized TGA file. In addition to the partial image, it also "remembers" its original X,Y screen coordinates. The window is useful when importing image "pieces" into another TGA file (explained in greater detail in the section on Image Editing and Layout contained in Chapter 6).

3. SCN - Scene files are created in RIO to store settings and the constituent parts that are combined to form a complete scene. An example would be a scene that included the source path for an included image (TGA file), information about font and object colors and sizes, spatial arrangements, and background treatments.

4. OBJ - Object files are also created in RIO. They store information about individual vector-based entities used in building a scene. (e.g., a rectangle or line of text).

5. SHO - This file is created in Panorama and contains the information for an individual video "slide show." It keeps track of the sequence of images, paths, time durations, transitions, etc.

6. ZIP - Files with the .ZIP extension are those which have been compressed using the compression utility PKZIP*. PKZIP can compress program, text, and graphics files to save space on the hard drive or to store old files in an archived form. For example, if the file "PICTURE.TGA" were compressed using PKZIP; the new file would become "PICTURE.ZIP" and would contain all of the data necessary to recreate the original file when extracted. This handy utility has been included as a selection on the MCS menu interface.

File Naming Conventions. File and directory management can be greatly simplified by using standardized file naming guidelines. Files can then be associated with important information about the image's origin, level of completion, relationship to other images, specific project references, etc. This allows files to be identified quickly without having to view each one individually to locate the needed image. It also can help by alphabetically grouping similar project files together. A file naming system

*PKZIP is the copyrighted property of PKWARE, Inc., 7545 N. Port Washington Rd., Glendale, WI 53217.

needs to conform to the particular needs of the installation and its anticipated projects. Following is an example of a basic system that could easily be employed.

All project file names would be eight characters in length with the TGA extension. For example:

PROJECT FILE: **FST2803B.TGA**

File names are coded to provide the maximum amount of information about the project, where the picture was taken, and other referencing information. The sample coded file listed above is described below:

<u>Project Code (**FS**)</u>. This code consists of two letters that describe and are unique to the current video simulation project underway. This helps with file management by alphabetically grouping all related files together.

<u>Location Code (**T28**)</u>. This three character code describes the photo location. Here it refers to a tank training area. Other codes might include: CON for contonement area, AER for aerials, R14 for particular ranges, IMP for impact area, etc.

<u>Image Reference Number (**03**)</u>. This two-digit number acts as a unique identifier for each image. The numbers are usually sequential, e.g., 01, 02, 03, etc.

<u>Status Code (**B**)</u>. The status code is a one-character code that indicates editing progress and image sequencing. For instance, numbers could be used for draft simulations while letters could designate finalized simulations.

<u>Directory Structure</u>. Application software and project data files should reside in separate directories to facilitate greater efficiency in file management. Similar applications should be kept together for easy interfacing between them. In like manner, data files should be grouped together by project. This would give quick access to a variety of file formats and would assist in backing-up the project files in one step instead of having to specify several different directory paths. For large projects, it may be necessary to separate files alphanumerically or by file type to keep directories under the size of the back-up storage medium (e.g., under 44 Mb if backing-up to a Bernoulli removable cartridge).

Another option may be to actually have applications and project files on separate drives of a partitioned hard disk. For example, applications may be located on drive C: while all project files would be on drive D:. The diagram in Figure 4 illustrates both approaches.

Disk Management

Fixed disk, hard disk, and hard drive are all synonymous terms describing the nonremovable internal disk in the computer. Understanding some basics about disk operations like formatting, data storage, and data file backup are important to protect project data and time.

Formatting a disk prepares it so that DOS may read from and write data to the disk. Trying to access an unformatted disk will result in a "General Failure" error. The hard disk included with the Video Simulation Workstation has already been formatted and there should not be a need to do it again. The only time that formatting will be necessary will be to prepare diskettes for use. Normally, the reformatting of a disk or diskette results in the loss of any previously stored data. To protect the hard disk and diskettes from accidental formatting, a selection has been included under the "Utilities" heading of the

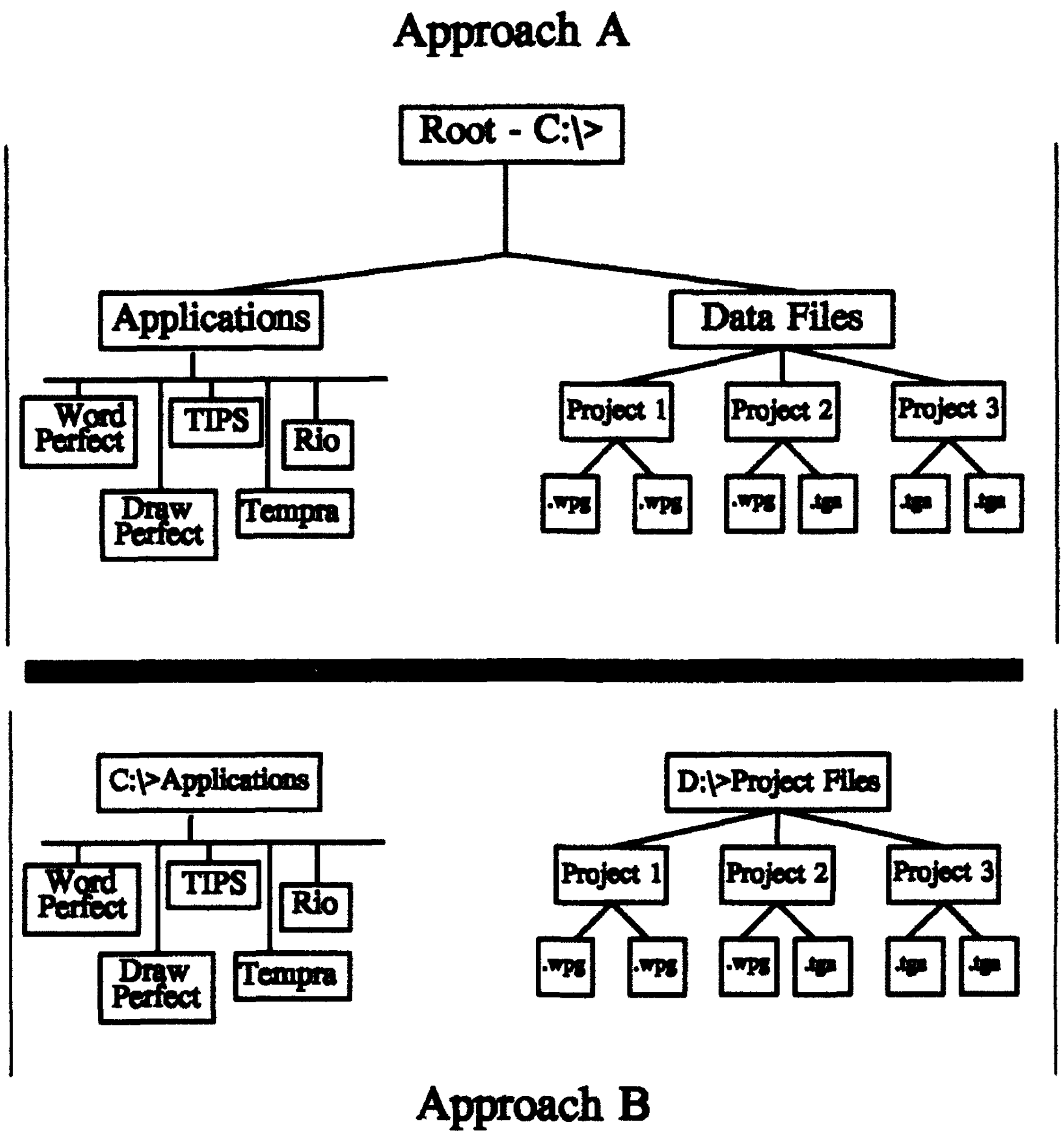


Figure 4. File Directory Structure Diagram.

MCS menu called "Tools." Safe Format is an option that has built in fail-safes to protect accidents and lost data. Even if a disk is accidentally safe formatted, the information can be retrieved.

There are several other tools designed to help with file and disk management chores in the "Tools" submenu. These specialized tools should be explored and used to make simulation and related tasks as efficient as possible. "Tools Help" is a selection that provides basic help for each of the tools and how to use them.

The hard disk is used to store program and data files for easy access and use. Barring any unforseen catastrophe, files stored on the hard disk should remain there indefinitely. However, this can not be completely assured, and steps taken to prevent loss of valuable data files can save hours or even days of labor. Project data files should be periodically backed up to some external storage medium. During the active (production) part of a project, this might be done weekly or even daily.

Commercially available back-up software is available for this task. DOS 5.0 has backup and restore commands for this purpose. Another option that is included with the Video Simulation Workstation under the "Tools" menu selection is the PKZIP compression utilities. These utilities will compress one or more files into one ZIP file that can be stored temporarily to provide more hard disk space or to archive files for long-term storage. Another useful utility is the "split/combine" tool, which can split large files up onto several individual diskettes. This is especially handy for sending TGA files to another party (such as a service bureau) that can combine the split files to produce slides or other specialized output.

Integrating Video Simulation With Other Systems

It may be possible to integrate video simulation with computer aided design (CAD) and global positioning system (GPS) technology to improve simulation accuracy, to evaluate the feasibility of video simulation preparation using UNIX-based computer platforms, and to integrate video imaging and the Geographic Resources Analysis Support System (GRASS) for geographic data visualization (Appendix B).

4 IMPORTANT CONCEPTS AND DEFINITIONS

This chapter summarizes some important imaging concepts: pixels, resolution, aspect ratio, color depth and T Mode. These are briefly described in nontechnical terms to provide the necessary background in imaging technology.

Pixel

A TGA image is made up of hundreds of thousands to millions of tiny pixels ("picture elements"), which are small rectangles or squares arrayed in rows and columns. The computer stores color data separately for each pixel, and displays the numerous pixels and their colors simultaneously to make an image. Thus, a TGA image file stores data about the number of pixels in an image, the color of each pixel, and the location of each pixel within the array of pixels that make up an image. The concept of a pixel can be graphically illustrated by calling up an image in TIPS+ or in RIO, and using the zoom function to magnify a portion of the screen image. Zooming in on an image magnifies the pixels' apparent size so that they can be easily seen individually by the human eye.

Resolution

Another important imaging concept is resolution. Resolution refers to the fineness of detail in an image, and is a function of the number of pixels in an image. High-resolution images contain more pixels and show more detail, while low-resolution images contain fewer pixels and show less detail.

File resolution refers to the number of pixels in the actual TGA file. Display or screen resolution refers to the maximum number of pixels that can be displayed by the TARGA+ board and monitor display system. A TGA file can be enormous; file resolutions of 2000 pixels wide by 1000 pixels high, or even of 4000 x 2000 pixels are common, while the maximum display resolution of the TARGA+ board is 1024 x 768 pixels. Thus not all of the pixels in a high-resolution TGA file (e.g., 2000 x 1000 pixels) can be displayed at once using a TARGA+ board.

There are two ways to approach the display resolution limits of the TARGA+ board. Either a portion of the high-resolution image can be cropped out, or pixels can be selectively removed from the displayed version of the high-resolution file until it does not exceed the display resolution of the board. In fact, some video software packages, including TIPS+, TIPS TypeRight, and Panorama will display only a portion of a high resolution image. If a high-resolution image is displayed in one of these packages, the screen will be full, but much of the actual TGA file image will be cropped, and only the lower left corner of the file image will be displayed. Packages that can only display a portion of a high-resolution file are called "screen-resolution" packages, since they can only display an image in its entirety if the file resolution does not exceed the display or screen resolution.

RIO can display a high-resolution file in its entirety, because it selectively eliminates pixels from the displayed version of the high-resolution file until it matches or is less than the screen resolution. For example, when displaying a TGA file whose file resolution is 1512 x 972 pixels, RIO discards three-quarters of the file image's pixels so that the displayed image matches the screen resolution of 756 x 486 pixels. The colors of the remaining pixels are then manipulated to minimize loss of image quality. Eliminating pixels from the displayed version of the high-resolution TGA file causes a loss of detail, but by using extremely good algorithms for image processing, this loss of detail can be surprisingly small. Because RIO can display a high-resolution file in its entirety regardless of its file resolution, RIO is said to be "resolution independent." Resolution independence is a powerful feature that is very useful for getting the highest quality output from the system.

Aspect Ratio

The term "aspect ratio" refers to two different concepts important to videographics: image aspect ratio is the ratio of an image's height to its width, while pixel aspect ratio is the width-to-height ratio of the individual pixels that make up an image. An understanding of both aspect ratio concepts is important for producing videographic output in the desired format without spatial distortion.

Image Aspect Ratio

Each output format has a specific image aspect ratio associated with it; landscape mode 35mm slides are always 0.666 times higher than they are wide (i.e., the image aspect ratio = 0.666), while standard printed pages in portrait mode have a height-to-width ratio of approximately 1.29. Videographic monitor displays have aspect ratios of 0.75, between that of landscape-mode slides and portrait mode standard pages. Note that the aspect ratios do not have units, but only describe the relative dimensions of the format.

To print an image without either clipping image contents or adding extra border space, the image aspect ratio must match the aspect ratio of the desired output format. If, for example, the final image is to be output as a landscape-mode 35mm slide, the image must conform to the 0.75 aspect ratio of the slide format. If the aspect ratio of the image differs from the desired output format, the image will usually be output with extra border space around the image, or in some cases, the image content may be clipped to conform with the aspect ratio of the output format.

If the simulation preparer plans to produce output in several formats that do not share the same image aspect ratio, (e.g., 8.5 x 11-in. prints, 35mm slides, and videotape), and does not wish to clip any of the images or have extra border space around them, then a different image must be produced for each output format. In practice, this means that the image should be recomposed (using RIO) in each of the desired formats. A good rule of thumb is to scan the image at high resolution in 35mm slide format, so that the whole image is scanned, and then trim the image as needed for other formats, such as prints or videotape.

Pixel Aspect Ratio

Pixel aspect ratio refers to the width-to-height ratio of the displayed pixels in an image. The displayed pixels in an image are not necessarily square, but actually vary with the display resolution. Only the 640x480 and 1024x768 pixel resolution modes of the TARGA+ use square pixels—all other display resolution modes use nonsquare pixels. For example, the 512x400 pixel mode uses a pixel aspect ratio of 1.07 (7 percent off-square), while the 756x486 mode uses a pixel aspect ratio of 0.8571—nearly 15 percent off square.

The practical implication for the user is that, if the display resolution is changed, the pixel aspect ratio will change, introducing spatial distortion into the displayed image. An image composed and saved at a display resolution of 756x486 pixels that is then displayed at a resolution of 512x400 pixels will be noticeably "squeezed" vertically and extended horizontally, as well as being clipped.

The user must consider pixel aspect ratio when scanning and displaying images. It is not desirable to produce final simulations with spatial distortions. To avoid this problem, it is best to scan and display in resolution modes that use square pixels. This insures that prints and slides will be spatially accurate, using the default settings for these output formats. If images must be displayed in a mode using a nonsquare pixel aspect ratio, they should be scanned at that pixel aspect ratio. However, if this is done, care must be taken to compensate for the nonsquare aspect ratio when producing other forms of output. In some cases, showing a simulation with slight distortion may be acceptable, for example when showing conceptual simulations.

Color Depth

Computers can basically understand only two conditions: on and off (1 or 0). All information processing done by a computer is ultimately based on this, and so, binary numbers are used to define any given piece of information, such as the color of a pixel. Nearly all of the information in a TGA image file consists of coded information about the color of each pixel in the image. The code for the color of each pixel consists of a binary number specific to that color. A binary number defining the color of one pixel might look like this: 01000110. The number of binary digits used to encode color information in an image file is directly related to the number of colors that can be contained in the image, and is referred to as color depth.

Most computers currently sold come with 256-color display systems, and use graphic file formats that allow 256 colors to be contained in one image. Such displays are said to employ 8-bit graphics, and image files that allow a maximum of 256 colors are said to have a color depth of 8 bits, since the binary number used to encode each color has 8 digits. It takes 1 bit of memory to store each digit, thus 8 digits of information provide 8-bit color information. A possibility for 256 colors exists with this arrangement, because there are two conditions (1 or 0) and eight digits ($2^8 = 256$).

The TGA file format and the TARGA+ board can specify and display files with color depths of 16 or 32 bits. Thus TGA files are said to be 16-bit or 32-bit images. A 16-bit image can contain up to 32,768 different colors (2^{15}—15 bits for color information and one bit to specify other information about pixel transparency). A 32-bit image can specify over 16.7 million different colors in one image (2^{24}—24 bits for color and 8 bits to specify degrees of pixel transparency, hence 32-bit images are often said to have 24-bit color).

The human eye is extremely sensitive to variations in color, and can actually "see" more than 32,768 colors. Because they cannot display as many colors as the eye could detect, 16-bit images and displays are said to not have "true color." Since 32-bit images and displays can contain far more colors than the eye can detect, they are said to achieve "true color."

To achieve the highest image quality and utmost realism, 32-bit images should technically be used for simulation preparation. However, in most cases, it is difficult to distinguish 16-bit images from 32-bit images, and 16-bit images are much smaller in size. Because so much more information is required to describe color, 32-bit images can be incredibly large; high-resolution 32-bit TGA files can sometimes exceed 40 Mb per image. Even low-resolution 32-bit images are usually several megabytes in size, and are slow to process, and difficult to store. Unless achieving the incremental improvement in image quality is critical, the 16-bit TGA image file format should be used whenever possible.

Digital, Analog, and Video Signals

A variety of monitor types can be used to display computer-generated graphic images, but the three most important monitor types for videographics work are: digital monitors, analog monitors and video monitors.

The VGA monitor supplied with the video simulation workstation is a digital monitor. Digital information about the color values in the image are used directly to create the display image, and the signal that carries the display information is called a digital signal.

The large monitor used to display the TGA images is an analog monitor. Digital information contained in the image file is converted into a wave signal known as an RGB analog signal. Frequency modulation rather than digital information is used to display colors, and consequently, analog systems can display any color, and are not limited to the 256 colors of the VGA display. The digital-to-analog conversion process is performed by the TARGA+ board, and involves splitting the color of each pixel into separate red, green, and blue components, along with a synchronization signal used to register the component signals when displayed on the monitor. Each color component and the sync signal are carried as separate signals on separate wires, which is important to achieving high image quality. Analog displays can be quite sharp, and achieve good color fidelity, as well as being unlimited in the number of colors they can display.

A standard video monitor (not a television) is often used to display imagery from videotape or from a video camera, and requires an NTSC composite video signal. A composite video signal is a wave signal that carries the same information as an RGB analog signal, but is not broken down into separate red, green, blue and sync components. All color information is carried on one signal, and for technical reasons this results in greatly inferior image quality relative to an RGB analog signal. NTSC refers to a particular format for the information carried on the signal. The NTSC format is the standard for video broadcast equipment in the United States, but adhering to this format results in further degradation of image quality. However, the loss of image quality is at least partly compensated for because of the great convenience of being able to display images on standard VHS video equipment and thereby reach a much larger audience.

In addition to putting out an analog RGB signal, the TARGA+ can directly output an NTSC composite video signal to a VHS video cassette recorder. This allows simulations and support graphics created on the video simulation workstation to be directly output to videotape, although with a significant loss of image quality. The TARGA+ can also convert a composite video signal into an RGB analog signal and eventually into the digital format required to make a TGA image file. It is this capability that allows the TARGA+ board to be used for image capture from videotape or a video camera.

TMode

A software program called TMode sets up the resolution, pixel depth, and video format of the TARGA+ board. Unless using RIO, the TMode program must be run to change the display resolution of the board, or to change the color depth, e.g., from 16- to 32-bit images. These parameters can be changed from within the RIO and Panorama packages, but not from within TIPS+, which must be exited to run TMode from the DOS command line to change the display options.

TMode is an option on the MCS menu that comes up when the machine is turned on. After selecting the TMode option, the user is prompted to respond to a series of questions regarding display options. Always select NTSC as the video mode, and interlaced display, as both parameters are required to output or input to video. Also, be aware when selecting display resolutions that even though the

TARGA+ board may support a particular resolution, the software packages may not be compatible with all board resolutions. Consult the software manuals for compatible display resolutions.

TMode can also be run directly from the DOS command line, by simply typing "TMode" at the DOS prompt. TMode can be run non-interactively from the DOS prompt by typing TMode followed by arguments that list desired resolution parameters. Consult the TARGA+ Reference manual for instructions and list of acceptable arguments.

5 QUICKSTART

The following tutorials are not designed to replace the tutorials found in the software documentation for each of the video simulation applications included with the workstation. They are much more detailed and should be used to begin gaining the basic skills necessary to produce quality video simulations. The following tutorials are to give the user a quick introduction to TIPS and RIO using a simple step-by-step format, to build confidence and allow the user to begin some basic tasks right away. Only a few tools will be discussed in each tutorial, but hopefully the user will get a "feel" for the software and how it functions.

Some conventions apply to the step-by-step instructions. Commands placed within brackets refer to a key or mouse button that is to be pressed (for example: <cancel> refers to the right mouse button, <select> refers to the left mouse button, and <Esc> refers to the escape key on the keyboard). For most purposes <select> and <Enter> mean the same thing and may be interchanged. Menu commands in the applications will be in boldface type (for example: **Proxy** or **BLND**).

TIPS Tutorial

TIPS is an icon-driven program used to edit TGA images to create video simulations. The appearance and location of the icons will always be described. To invoke TIPS:

1. From the DOS prompt, type: "menu 1" then <Enter>

2. Use arrow keys or mouse to <select> the menu item **TIPS PLUS**

3. When the TIPS title block appears, <cancel>

4. <select> drawing tools icon (row 1, col 1)

5. <select> clear screen "thumbs down" icon (row 4, col 3) and <select> **yes**, then <cancel> to return to main menu

6. <select> the disk icon (row 5, col 4) from the main menu

7. <select> **load** then **pic**

8. <select> the TGA file **Eagle**, then <select> **YES** (NOTE: The image may not fit the screen as the spatial resolution of the file may not match the current resolution of the software)

9. <cancel> to return to main menu

10. <select> Drawing Tools icon (row 1, col 1) then <select> Move icon (row 1, col 5)

11. <select> the **framed** option, then <cancel> three times

12. When the crosshairs appear press <select> and move cursor to drag box, <select> again to complete box

13. Move cursor around perimeter of box and notice the icons. <select> one and experiment with it

14. Select the "hand" icon by holding the <select> button down and moving the mouse, then release the <select> button when the frame is in the desired position

15. <select> the "square" icon at the lower left corner of the box, then <cancel> (NOTE: This pastes the frame down)

16. Use the Framed Move tool to move and manipulate several portions of the image.

17. <cancel> to return to main menu

18. <select> Special Effects menu icon (row 2, col 1), then <select> **BLND** command and <cancel>

19. <select> Drawing Tools icon (row 1, col 1), then <select> Freehand Draw icon (row 1, col 2) and <cancel>

20. <select> Brushes (row 3, col 1), then <select> any brush shape and <cancel> twice

21. Hold down <select> button and move cursor around image and notice the blending effect

22. Practice Blend and Framed Move commands, then <cancel> to return to main menu

23. <select> disk icon (row 5, col 4), then <select> **save** and **pic**

24. Type in name for new TGA file (not to exceed eight characters), then <Enter>

25. <cancel> to return to main menu, then <select> DOS icon (row 5, col 5) and <select> **YES** to exit TIPS

RIO Tutorial

RIO is a powerful and complex graphics and layout package. It can be used to add titles and graphics to TGA images to further clarify and improve the effectiveness of the simulation. It can also be used to input and output high resolution files for high quality simulation work, but this aspect of RIO will not be covered here. To invoke RIO:

1. From the DOS prompt, type: "menu 1" then <Enter>

2. Use arrow keys or mouse to <select> the menu item **RIO**

3. When the RIO title block appears, <cancel>

4. <select> **OPTION** menu, then <select> **Background**

5. <select> **Type:** until the "Image" option appears

6. Then <select> **Image:** at the bottom of the submenu

7. <select> the Drive and/or the Path designation and <select> the path where TIPS resides (e.g., C:\TIPSPLUS), then <cancel>

8. <select> the image that was saved during the TIPS quickstart tutorial, then <cancel> twice

9. <select> the **OBJECT** menu, then <select> **Rect**

10. Examine each option under the three different attribute headings by using <select> and <cancel>

11. <cancel> again to return to screen

12. Position cursor, then <select> and drag rectangle outline, <select> again to create rectangle

13. <cancel> to drop tool

14. Place cursor on top of rectangle and <select>, then move cursor around perimeter of highlighted bounding box (notice the icons)

15. <select> "moving box" icon and move cursor, <select> again to put down box

16. Experiment with the other icons, then <select> the **DESEL** icon in the center of the rectangle to deactivate bounding box

17. Press <cancel> to return to menu

18. <select> **OBJECT**, then **Text**

19. <select> **Font: (Like):**

20. <select> HOBOKB.FNT from the list of available fonts

21. Examine each option under the three different attribute headings by using <select> and <cancel>

22. Press <cancel> when ready to place text

23. Place cursor on rectangle and <select> to insert text

24. Type in: "Test" and press <select>

25. <cancel> twice to drop tool and return to menu

26. <select> **CONTROL**, then <select> **Render**

27. <cancel> twice for menu

28. <select> **I/O**, then <select> **Print to file**

29. <select> **Output file:**

30. Type in a name for the new TGA file, then <Enter> (NOTE: DO NOT use the same name as previously used for the file created in TIPS)

31. <select> **Print**, then <cancel>

32. <select> **CONTROL**, then <select> **Quit**

33. <select> **Yes**, then <select> **No** to exit RIO

6 SIMULATION PREPARATION PROCEDURES

This chapter describes recommended general operating procedures for producing visual simulations of training area impacts. These recommended procedures are intended to be general guidelines for persons new to the video simulation system. With expertise and experience, users may wish to vary or refine procedures to suit their own or project needs. For those familiar with video simulations, or those who wish simply to read some brief instructions, the previous section "Quickstart" will suffice.

General

The process of preparing simulations for a particular project can be broken down into several steps (Figure 5). Procedures will vary somewhat with different input and output formats, image quality requirements, and time constraints.

Before beginning the actual simulation process, the preparer must decide whether the desired output format will be a videotape, 35mm slides, hardcopy prints, or overheads, etc. Image quality requirements may vary; sometimes video quality images are adequate, sometimes very high quality slides are needed for an important public meeting. Hardcopy prints may be useful for briefings or informal discussion.

The choice of output format and quality is important because certain formats are easier to produce than others. For example, high-resolution images are slower to process, take up more space, and are relatively more cumbersome to work with than low-resolution images. However, the output quality of higher-resolution images is much better than that obtained from screen-resolution images (i.e., where the whole file can fit on the screen). Output format and quality requirements dictate input method—high quality output almost always requires scanned input. If quality needs are lower, it is quicker to use images captured from videotape.

The first step is to use a video camera or 35mm camera to acquire the images of the existing landscape that will serve as base images for the simulations. Remember that scanned images are almost always sharper and have better color fidelity than video images, and will result in higher quality simulations regardless of the final output format.

If image-quality needs allow the use of video-captured images, use the "Capture" option in RIO to grab images from videotape. If higher quality images are required, use a slide scanner and the "Scan image" option in RIO to scan a 35mm slide or negative into a TGA file format.

Most image editing will be done using the TIPS software application, using the "cut-and-paste" tools such as "framed move," "window," and "blend." Images scanned using RIO must be imported into TIPS for editing. High-resolution files (files larger than the screen resolution) must be edited using the proxy edit feature in RIO, which provides temporary access to TIPS for editing purposes (see the following section on Editing and Layout).

Usually the simulation preparer will wish to add labels and/or titles to images, or prepare text slides or support graphics such as maps, all of which can be done using tools in TIPS or RIO. The text, sketching, and layout tools in RIO are far more sophisticated and flexible than those in TIPS, and generally result in better looking graphics than can otherwise be produced.

The last step in preparing images is to produce output. Output procedures differ depending on the package used to produce the finished image, and the output format.

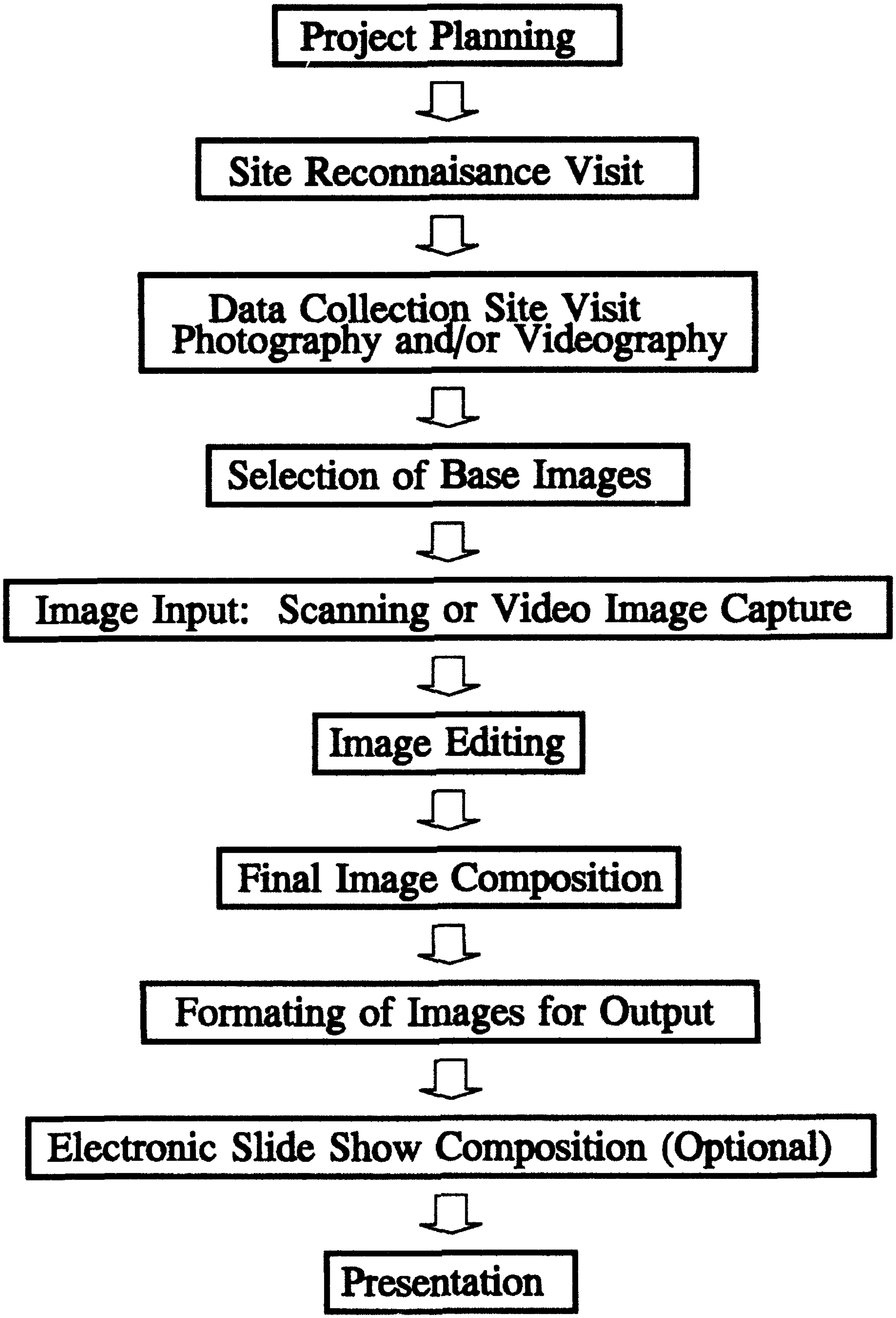


Figure 5. Detailed Simulation Process Flow Diagram.

If a "video slide show" is the desired output format, screen resolution files produced in TIPS or RIO can be imported directly into Panorama for slide show creation. Using the TARGA+ NTSC composite video out signal, the slide show can then be output to videotape using a standard VHS video cassette recorder.

Screen resolution files produced in TIPS or RIO can be output as hardcopy prints or overheads through RIO directly. High-resolution images, or images that have had text or labels added in RIO will produce much sharper images if RIO's "print to file" function is used to create a very high-resolution TARGA+ file before printing. This assures the best quality output.

If 35mm slides are the desired output, the images must be stored on floppy diskettes and sent to a graphics service bureau for film recording, since the workstation does not have slide-making capability. Such service bureaus can accept files in the TGA format and produce very high-quality slides in as little as 24 hours.

Image Capture

This section presents general principles and procedures for photographic and video image capture for use in preparing simulations that should apply to most field situations. Appendixes B and C contain some basic information on photography and 35mm cameras.

Two considerations apply equally to images captured with 35mm or video cameras: weather and time of day. As scanned images, photographs taken under sunlit conditions usually look better than those taken under cloudy conditions for several reasons. First, sunlight produces shadows that often give a photo more apparent depth and detail—photos taken under cloudy conditions may appear flat, and lack detail. Sunlight also intensifies colors, while overcast reduces color saturation, making images appear dull and washed-out. This dullness is often further increased by the scanning or video-capture process, resulting in dim, uninteresting images. If image quality is a major concern, or the ability to discern fine details is important, then sunlit photographs usually suit the purpose better.

On the other hand, sunlit photographs are usually more difficult to edit than photos taken under cloudy conditions, due to the difficulties of rendering shadows and simulating the subtle effects of light falling on lit surfaces. Windows (or portions of TGA files) can be more easily exchanged between nonsunlit images, since there are no shadows, and colors match more easily. Where image quality and detail are less of a concern, nonsunlit images may be satisfactory.

On sunny days, the best times of day for simulation photography are usually mid-morning and mid-afternoon. At these times color saturation is generally good, while shadows are long enough to increase detail and depth perception, but not so long that they obscure details. In places where early morning fog lingers, mid-afternoon may be better for photography. On cloudy days, light tends to be even, so that time constraints depend on brightness rather than sun angle.

Using a 35mm Camera to Capture Images for Simulation Preparation

The following guidelines describe general principles and practices suggested for photography for visual simulation at Army training areas. These principles pertain to general conditions desirable for simulation photography, as well as specific photographic techniques that are useful in most circumstances.

Photography requirements for conceptual simulations are the least stringent of the three methods presented here. These simulations are usually created for demonstration purposes, or for discussing design proposals. Since strict accuracy is not required, the photographer is generally concerned primarily with obtaining the best quality image in terms of lighting, exposure, focus, and ease of editing. Procedures for taking panoramic photograph sequences are discussed below, as well as taking images for use as a library of "window" objects for editing.

Focal Length. For most simulations, 50mm focal length is standard, since this approximates the size of objects as seen by the human eye, and minimizes spatial distortion. In some cases, wider angle views may help to show context, or telephoto views may show details; however, such views inevitably distort size and spatial relationships of objects in the photo. Thus wide-angle and telephoto images are not usually considered "accurate" in the strict sense of depicting the landscape as seen by the eye. Their use in visual impact simulation must be carefully controlled. Extremely wide-angle or telephoto images should be avoided.

Polarizing Filter. A polarizing filter is useful in sunlit conditions where the distance between camera and subject is large (since haze is more noticeable over large distances). If the air is extremely clear, the distance between camera and subject is small, or under cloudy conditions, a polarizing filter will have little or no effect. A polarizing filter will only function properly if the direction of the photo is at an angle to the sun's rays; maximum polarization occurs at right angles to the sun's rays. Minimum polarization occurs when photo direction is directly toward or away from the sun (Figure 6).

The polarizing filter is operated by turning the outer ring on the filter while looking through the camera viewfinder. Under the right circumstances, the image in the viewfinder will change as the ring is rotated. The effect is particularly noticeable when viewing a partly cloudy sky. At maximum polarization, the contrast between sky and clouds is often greatly increased; the sky will darken considerable while the clouds remain white. After rotating the filter to achieve the desired degree of polarization, the photograph is taken. Since most simulation photographs are taken with the focus set to infinity (the focusing ring is turned off, or all the way to the left), it is better to turn the polarizing filter ring to the left as well, so that it does not throw the lens out of focus.

Lighting. On sunny days, photos should be taken at mid-morning or mid-afternoon, for reasons already mentioned. Taking photos around noon should be avoided, as these images tend to appear washed-out and flat. If the sun is low in the sky, taking photographs toward the sun's direction should also be avoided, as good exposure can be very difficult under these circumstances.

Exposure. The safest way to ensure good exposures is to "bracket" shots—that is, in addition to shooting an image at the exposure the camera meter indicates, deliberately over- and under-exposed additional images should be taken. The camera meter can be "fooled" by high contrast lighting into indicating an exposure that will not properly expose the elements of interest. Bracketing helps guarantee a good photograph, even if the meter is "fooled" into an improper exposure.

In addition to bracketing, in situations where high contrast is a factor, such as when photographing a dark landscape against a bright sky, careful use of the camera's light meter can help assure proper exposure. This technique involves metering only the elements of the image that must be exposed properly. In simulation work, the object of focus must be exposed properly; proper exposure for the sky is less important. If the camera meter reads only light from the landscape, and does not meter the sky, the landscape will be properly exposed.

For example, when shooting a dark foreground against a bright sky, the camera should be pointed at the ground while taking the meter reading. This meter reading will indicate the proper exposure for

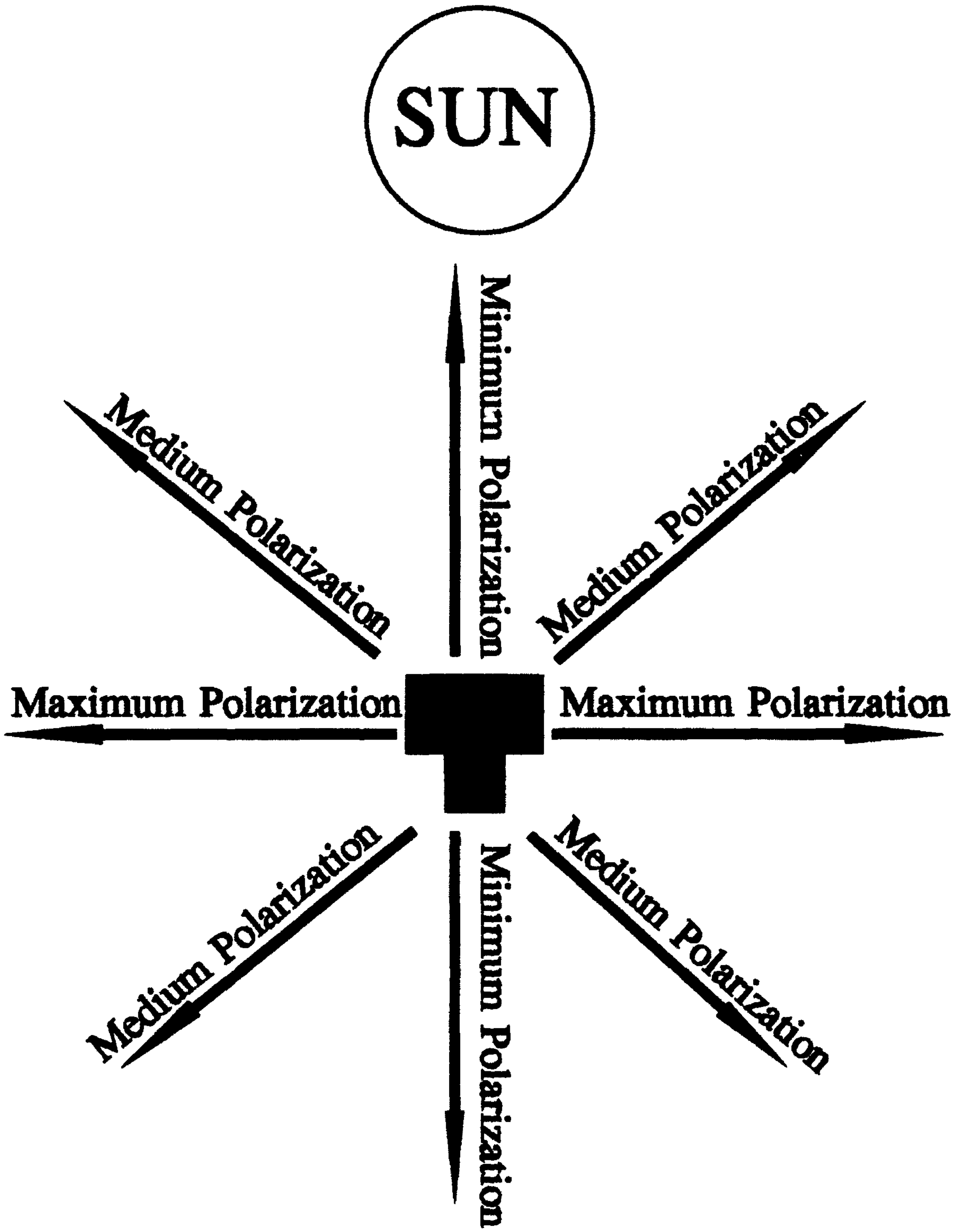


Figure 6. Polarization With Respect to Sun Direction.

the landscape. The photographer should then compose and shoot the desired image, including the sky, using the meter reading for the ground. The resulting photograph will show the ground at proper exposure, but overexposes the sky. A good general rule is to take a meter reading on only the elements you are interested in, then compose the photograph and shoot it using the exposure indicated for the elements of interest. This method, combined with bracketing, will almost always result in at least one acceptable image.

Focus. Almost all simulation photographs will be taken with the focus set at "infinity." Occasionally, focus problems may be encountered when foreground objects in the image are out of focus, such as grass or scrub immediately in front of the photographer. These objects can often be brought into focus by raising the f-stop, that is, closing down the iris. (Appendix B includes a discussion of basic camera anatomy). Closing down the iris causes the depth-of-field to increase, thereby bringing objects closer to the photographer into focus. The closer the objects are to the photographer, the higher the f-stop must be raised to bring them into focus.

Panoramic Photograph Sequences. Shooting panoramic sequences of photographs that will be spliced together for a simulation image requires additional planning and slightly more stringent procedures than are required for standard single-image photographs. Planning issues involve choosing focal length, choosing the number of images in the panoramic sequence, and composing the sequence of images. Procedural issues involve the use of a tripod and composition of the individual images.

The use of short (wide-angle) focal lengths should be avoided, as they distort perspective and result in the appearance of multiple vanishing points in the final, spliced panoramic image. This effect is particularly noticeable at very short focal lengths, such as 28mm. While this effect should occur at any focal length, it is much less noticeable at longer focal lengths.

Usually, two or three images are appropriate for a panoramic sequence. Assuming 50mm focal length, it is difficult to fit more than three images onto the screen without having to reduce the size of the individual images so much that color and shape distortion occurs, and significant detail is lost. Using two images allows larger images, but also reduces field of view, and introduces a seam directly into the center of the field of view. In some cases, the seam between the two images may be difficult to conceal. Also, slight differences in lighting between the two images may be more distracting, because the edges are in the center of the field of vision.

Assuming the object of focus is to be located in the center of the field of view of the panoramic simulation, it is desirable to avoid having image seams in the middle of that area, i.e., in the middle of the field of view. The natural tendency is to begin composing the sequence starting at the left end of the proposed field of view, then sweep across to the right. Unfortunately, this practice often results in distracting seams that appear in the middle of the impact area. A better method is to first compose the middle image, ensuring proper framing without seams in an important part of the image. Then the outside images can be composed based on the boundaries of the middle image (Figure 7). Seams are then guaranteed not to appear in areas of critical interest.

Whenever possible, use a tripod for the panoramic sequence to assure proper horizontal alignment of the images. Although panoramic series shot with a handheld camera are generally useable, nonaligned parts of the images must be cropped out of the final image, thereby further reducing the size of an already reduced image.

The major concern in composing individual images in a panoramic sequence is to ensure proper overlap of the images, so they can be aligned properly without intervening gaps. Too much overlap results in smaller useable images in the sequence, and possibly more resulting seams. Having no overlap

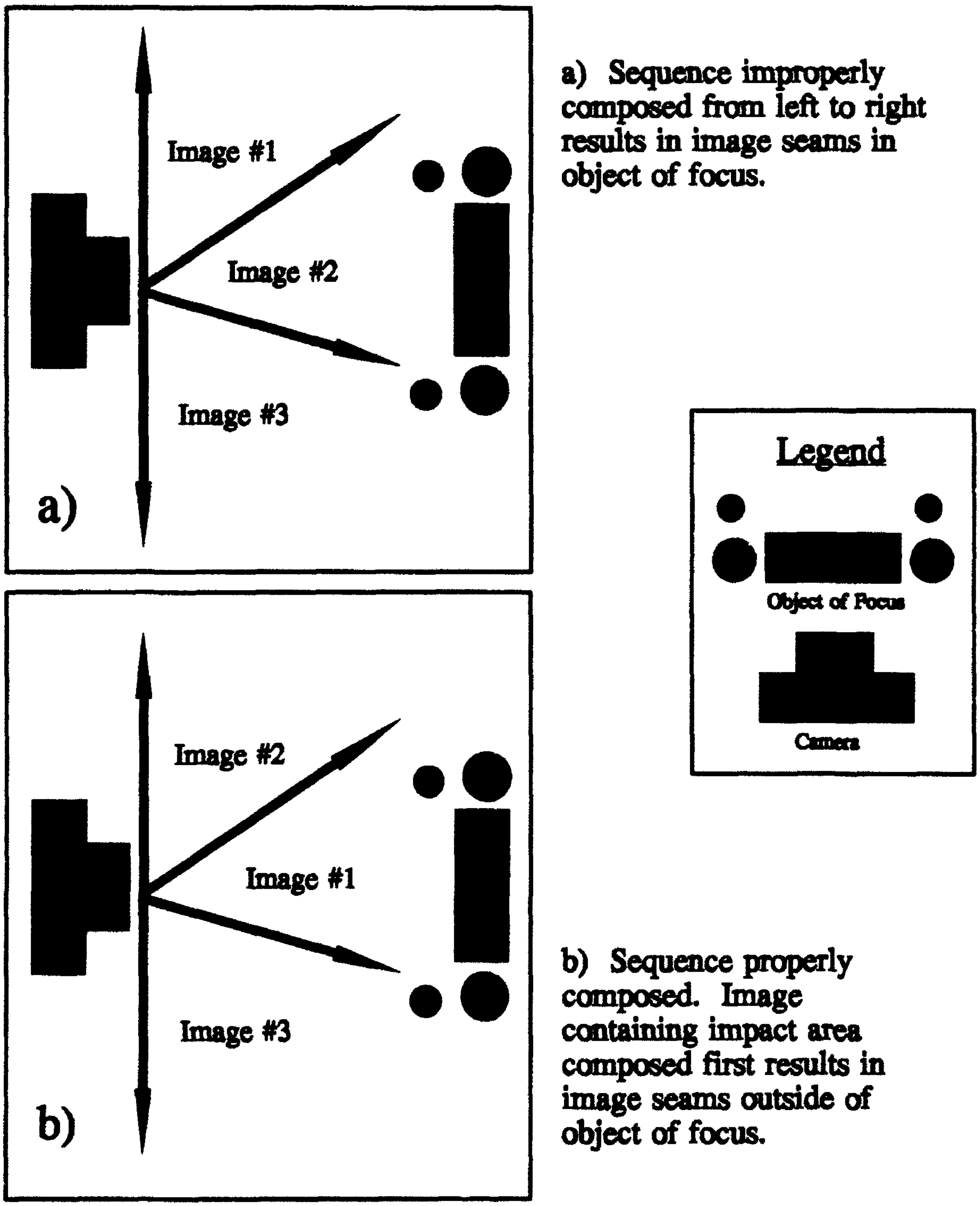


Figure 7. Panoramic Sequence Composition.

will cause gaps to appear between the images. If there is very slight overlap, it may be difficult to align the images because photographs are most distorted at edges and corners. The objective is to get as wide an image as possible while ensuring overlap.

Caution must be exercised when using a polarizing filter while shooting a panoramic sequence. Since the angle of the shots relative to the sun changes as one moves through the sequence, some photos in the sequence may be polarized differently than others. In extreme cases, one of two shots from a sequence may have dark blue, contrasted skies while adjacent images have light blue, washed-out skies, creating an obvious discontinuity in lighting. This problem can be easily avoided by checking the degree of polarization for the various images, and deciding whether or not to use the filter based on the results of that check.

Photography Guidelines for Library Images. To be useful, library images must be compatible with target images in terms of lighting, scale, and visual perspective. Incompatible lighting is probably the most common reason that library images cannot be successfully integrated into target images, followed by incompatible perspective and finally by incorrect scaling. On the other hand, editing software allows a degree of manipulation of lighting and scale, but little can be done about library images that are not in proper perspective.

Generic image libraries such as that commonly sold by software vendors, are sometimes useful in conceptual simulations, but are of very limited use in cases where accurate and realistic simulations are required. The lighting of the library image will rarely match the target image, the perspective is likely to be inaccurate, and while scale can easily be adjusted, any large changes in scale will result in distortions in color and detail in the resized image. Where accuracy and realism are important, creating a custom library of images for each project is desirable.

In creating a custom library, the photographer seeks to match library images as closely as possible to the target images. Whenever possible, photos are taken at the same location, at the same time, under the same lighting conditions as the target images. To match perspective and scale, objects in the library windows must be photographed from the angle and distance that they will appear in the target image. This requires careful planning on the photographer's part, since simulation views must be planned out beforehand. It is highly advisable to take numerous photos from varying distances and angles, so that there is a large body of images to select from, to respond to the subtleties of accurate scale and perspective. Bracketing of shots helps assure that subtle differences in lighting can be addressed without post-processing of the images.

Using a Video Camera to Capture Images for Simulation Preparation

The video camera has two main functions as an image capture device for video simulation preparers. A video camera can be used to capture base images for use in simulations, or to create live video segments that are used to provide supplementary information during a simulation presentation. This section discusses basic equipment and procedures for image capture using a video camera for both of these purposes.

Equipment. For most simulation uses, a standard VHS video camcorder is adequate. Other options are available, but use non-standard formats that would cause compatibility problems with commonly available equipment. Eight-millimeter or Hi-8mm video camera/players are usually less bulky and heavy than VHS camcorders, and are capable of better image quality, but use a non-standard tape format, and are usually more expensive than VHS units. S-VHS input/output capability is desirable for capture of base images because of better image quality, but requires non-standard equipment or conversion to VHS format for playback or live video segments.

An essential item is a lightweight video tripod. Hand-holding a video camera inevitably results in movement-related blurring of captured images, and in distracting camera movements during live video sequences. A tripod with an extended arm for panning is useful for shooting panoramic sequences. Other useful equipment includes extra videocassettes, spare camera batteries, and a notebook for recording data (Appendix C includes a list of equipment).

Capturing Base Images. With few exceptions, general guidelines for capturing base images with a video camera are similar to those for capturing images with a 35mm camera. Guidelines for best time of day, lighting, and weather conditions suitable for image capture are the same for both 35mm and video cameras. Differences between 35mm camera and video camera procedures arise primarily from differences in the cameras themselves. For example, video cameras generally cannot be equipped with polarizing filters, and generally do not have controls for shutter speed. This discussion will focus on procedural differences between the two systems.

Image Quality. Images captured from videotape are generally inferior in quality to those captured by a 35mm camera that are subsequently digitized with a slide scanner. Video images are much lower in spatial resolution than scanned 35mm photographs, and are also much more subject to color bleeding and loss of saturation, contrast, and sharpness. The real advantage of using the video camera to capture base images is convenience: image capture and digitization from videotape eliminates processing delays, and avoids the scanning process, which is both more complicated and more time-consuming than digitizing video images.

The generally low quality of video images should constrain their use to situations where image quality is not a primary concern, and also to conditions that favor the best possible image quality. Thus, hazy or foggy conditions should be avoided. The lack of exposure control can result in poor performance in low light conditions. Thus good lighting conditions are usually more important in shooting video than in shooting photographs. The low spatial resolution and color fidelity of video images means that fine details are often lost, so that distance between camera and subject may need to be decreased.

Camera Movement. Even slight movement of the camera can result in image blurring during the digitization process. If achieving the best possible image quality is important, it is essential to keep the camera still when shooting video from which frames will be captured and digitized. A tripod should be used whenever possible.

When shooting video that will be used as a live sequence during the final presentation, any planned camera movements must be carefully considered beforehand, and camera jiggle must be minimized. Camera jiggle is very distracting to the viewer, and rapid, jerky movements of the camera can actually make the audience experience motion sickness.

Panning (camera rotation) and zooming movements must be made very slowly and evenly, and it should be remembered that movement often seems faster during playback than when originally recorded.

If a sequence involves actually moving the whole camera along a line or curve (dolly shot), e.g., shooting video from a vehicle, try to avoid camera vibrations, and when possible, avoid filming objects in the immediate foreground as these objects appear to move extremely quickly, which can have a disconcerting effect on viewers.

Sound. Sound can be recorded while using a video camera to capture images for use in simulations or for live segments. Although sound recorded while filming will generally be removed or replaced by a presentation narration, the sound recording capability can be useful for "audio notetaking," that is, to record location, subject matter, and other relevant information about images being filmed. This information can be particularly useful if numerous images or segments are being filmed, as it provides an easy way to keep track of the images.

Image Input

There are two ways that an image can be input, or digitized, into a usable computer file format. The first is to "grab" a single image or frame from a video recording. The second method is to electronically scan a 35mm color slide. Both methods have advantages, but the marked improvement in quality of scanned images over video images is a strong incentive to use a slide scanner for image input.

Images grabbed from video are restricted to screen resolution and are generally lower quality because of the blurring and limited color replication inherent in video recordings. However, image input from videotape is faster as there is no waiting time for slide processing or the scanning process itself, which can be lengthy for high resolution files. Though the time involved may be longer, slide scanning offers the flexibility for creating high resolution files that boast much finer detail and true-color rendition.

The RIO software application supports both methods of image input. RIO performs many functions used throughout the simulation process, and is used primarily for text and labeling operations, for graphic layout and design, and controls the input and output of images. Only the functions pertaining to image input will be discussed here. For a more complete discussion of RIO's other tools and uses, see **Image Editing and Layout** (p 38). RIO is not a screen resolution package, but it is capable of inputting, displaying, and putting out high resolution TGA files. The procedures for inputting an image from either video or 35mm slide are each described below.

There are two common preliminary steps that apply equally to either approach:

1. Set page format (under the Option menu).

After entering RIO, the first step is to set the page format to match the desired output type. For example if the desired output is 35mm slides in landscape orientation, 35mm slide is selected from the list of possible page formats, and landscape orientation is selected from the submenu. Selecting the proper page format constrains the working area of the image to conform with the dimensions of the output format. In this case, the output image will conform exactly to the dimensions of a 35mm slide, without cropping or leaving borders.

2. Set display resolution (under the Option menu).

This operation is essentially the same as running TMode from the DOS command line. It should be remembered that an image can only be grabbed from video at the current screen resolution, whereas slides can be scanned at any predetermined resolution. For example the display (TMode) could be set to 512x400, which would restrict the resolution of grabbed video images to that setting (512x400). However, images from 35mm slides could be scanned at any resolution (e.g., 1024x800). The difficulty here is that these larger files cannot be simultaneously displayed for editing and layout purposes on the monitor or when being output to video tape.

To grab or capture an image from video a cable must be connected to the 9-pin DIN (round) input port on the TARGA+ board (the port closer to the top of the computer) and to the video out connection at the video source (e.g., a camcorder or VCR). After the connection is made, RIO is invoked and "I/O" is chosen from the main bar menu at the top of the screen. Select the "Capture" option. This will display a submenu with several buttons to choose from. Start the video and select "Focus" to watch the video uninterrupted and to make sure the signal is adequate. A single image may be captured by selecting the "Grab" button. The "Grab" button may be selected repeatedly until a desireable image is captured. If the image is blurred due to motion in the video, the "Field average" button can be selected to alleviate some of it. A portion of the captured image can be delineated and saved by using "Save window." The entire image is saved with the "Save" button. In both cases the DOS path and image type must be specified. The default image type is set to 16-bit uncompressed, which should suffice for nearly all applications. Type in the desired file name and press <enter>. The image on the screen will be saved to a TGA file.

To scan a 35mm slide in RIO requires a slightly different procedure. No video input is required; only the scanner itself is necessary. Select "I/O" from the main menu and choose "Scan image." Selecting this command brings up a scanning menu specifically configured for the scanner provided with the workstation. Scanning parameters and options can be selected by the user by choosing the "edit" button. The only options that may need to be changed are: Resolution, Min/Max settings, and Contrast. If the Resolution option is set to "File size," then the file width and height sliders should be set to the desired size (in pixels) of the final scanned image. The Min/Max settings are best when left on "Automatic," but can be changed to "Manual" for finer adjustments. "Contrast" can be experimented with to obtain the best scanned image. Best results are usually yielded when it is set close to 1.00.

If there is a "Calibrate" option, this should be selected before scanning any slides, and recalibration should be done every 30 to 45 minutes of scanning time. After selecting "Calibrate," you will be prompted to insert a dark slide and press <cancel>. This dark slide is a piece of black cardboard the size of a 35mm slide. Insert this into the slide holder and press <cancel>. Afterward, the user is prompted to insert the light slide. To do this, simply remove the dark side from the holder and press <cancel> again. This process "tells" the scanner how dark the color black should be and how light the color white should be when digitizing a given image. Calibration assures consistency in hue and tonal replication. Press <cancel> to escape the setup option submenu.

Choose "Preview" to get a quick black and white scan of the current slide. The setup option submenu can be edited until the preview image is acceptable. Selecting "Scan" will initiate a preview, if not already done, or will provide crosshairs to delineate the portion of the slide to be scanned. The crosshairs will automatically create a box in exact proportion to the aspect ratio of the "Page setup" as defined under the "Options" menu, so that the newly scanned image will fill the screen. If screen resolution images are desired, the "Scan to screen" option should be used. If high resolution files are desired, the "Scan to file" option should be used, and the desired resolution specified under the setup options submenu. For most occasions, the "Scan to file" option should be selected, even if screen resolution is being used. This saves the additional step of saving the screen image to file after it has been scanned. Again, the DOS path, file type, and file name must be specified. The slide is then scanned and saved to a TGA file in preparation for the next step in the simulation process.

Image Editing and Layout

This section briefly summarizes general procedures for operating the two main software packages used for simulation preparation - TIPS and RIO. In addition, some of the most commonly used tools for editing and graphic layout are discussed along with some pointers for their use.

Truevision Image Processing Software (TIPS)

TIPS is a relatively user-friendly icon-driven paint package. The user executes commands by selecting the appropriate icon with the cursor. Selecting some command icons causes a sub-menu to appear. Submenus consist of other icons or text that denotes an option for the command selected. Of the tools available in TIPS, relatively few are normally used for image editing, and it is possible to learn the basics of the package in a few hours. However, these tools are quite sufficient for almost all of the editing tasks that would generally be expected in a typical video simulation.

Before entering TIPS, TMode must be run to set the desired display resolution and color depth. When using the DOS menu, TMode is automatically run before any of the video software applications are invoked. For images that will eventually be part of a Panorama slide show, resolution cannot exceed 756 x 486 pixels, and color depth should be set to 16 bits. This TMode configuration is the default for the workstation, but may be easily changed using the "Change TMode" option under "Utilities" on the main DOS menu.

TIPS is a screen resolution image editing package; that is, it can only load and output images at screen resolution. By itself, TIPS cannot process high-resolution TGA files. However, if used in combination with the proxy edit tool in RIO, TIPS can be used to edit high-resolution images.

Tools within TIPS that are most used for image editing are reviewed below. Included in this list is "Framed move," "Window," "Tile," and "Blend." TIPS can be a very powerful editing package when its tools are combined to perform specific editing tasks that may otherwise be too difficult to accomplish with individual tools. An excellent example is the creation of a "Window" that can be imported and pasted into other images (e.g., a tree frcm one image could be cut out and imported to another image). This process is described later in this section.

The tools in TIPS are organized into groups. Each of these groups are identified by an icon in the lefthand column of the root menu. From top to bottom they are: Drawing Tools, Special Effects, Brushes, Patterns, and Colors. There are also some basic operation icons at the bottom including file storage and exit to DOS.

Framed Move. "Framed move" is an option under the "Move" tool contained in the Drawing Tools group. "Framed move" allows the image editor to select any rectangular portion of the on-screen image, copy it, and move the copy to a new location within the same image. The copied portion of the image can be enlarged or shrunk, rotated, flipped, and otherwise manipulated before being pasted down in a new location. This is done by selecting one of the icons that appear around the perimeter of the rectangle. This function can be useful for "removing" objects from an image, by simply covering them up with another portion of the image. For example, a tree can be removed from an image by covering it up with a "piece" of sky from within the same image, or a tank track can be covered with a "piece" of grass to show its appearance after revegetation. This tool is one of the most powerful contained within TIPS. One of its main drawbacks is that the portion selected can only be rectangular in shape. There is no way to create an irregularly-shaped frame with the move tool alone.

Window. An irregularly-shaped window can be created using a combination of the tools in TIPS and is similar to the framed move in several ways, but instead of moving portions of an image within the same image, windows are used to move portions of images between different images. For example, a vehicle can be cut out of one image and pasted into another image. This is done by saving the selected portion of the image as a separate file, called a WIN file, and then overlaying the WIN file on top of the desired image.

The portion of the image to be saved as a WIN file is selected in much the same way as a portion of an image is specified by a "Move" command. When the window is imported into a different image, it can be manipulated in exactly the same way as the rectangular box when using the "Framed move" command. For example a WIN file of a tank could be created in one image and imported to another where it could be enlarged and horizontally flipped so that it would fit properly in a different image.

Since TIPS can only save rectangular portions of an image as windows, an irregularly shaped object (such as a vehicle or tree without the background) must be "masked out." This is done by selecting the "Freehand draw" tool under the Drawing Tools group, choosing an appropriate size brush (depending on the level of detail needed when tracing the outline of the object), and selecting black as the current color from the color bar at the bottom of the menu. The object should be carefully traced with a black line so that it is completely separated from the rest of the image. The area surrounding the object in the window is then flooded with black color. The "Border fill" option under "Fill" in Drawing Tools should be used for this. The window is then defined by going to the Storage icon (the disk icon) at the bottom of the menu and highlighting first "Save" and then "Win." Use the cursor to delineate a rectangular box (similar to the "Framed move" command) and name the new WIN file. Load the image where the imported window will be pasted and then load the WIN file. TIPS makes the black color transparent, so that when the window is imported into a different image, the black outline does not appear and only the object itself is visible.

Tile. "Tile" is a tool found in the Special Effects group. To activate "Tile," select the appropriate icon in the Special Effects submenu. The submenu will disappear and be replaced with crosshairs. Use the crosshairs to delineate a rectangular box that contains the pattern or texture needed for editing the image. Once selected this box forms an array of "tiles" in the backbuffer, that is to say, the selected tile is repeated in rows and columns "behind" the existing image and can be "uncovered" using paint tools. For example, suppose the simulation called for revegetating an eroded area next to a tank trail. One solution might be to use "Framed move" to move pieces of grass and cover the bare soil up. However, a "tile" of grass could be defined and, using the "Freehand draw" tool and an appropriate brush, could uncover portions of the grass texture wherever it may be needed. The advantages are greater editing speed and the flexibility to work with irregularly shaped areas in the image. Tiles can be redefined as often as needed. The one danger with this tool is that if too much of the backbuffer is revealed, the pattern of tiles can be quite noticeable, so it is advisable to change the tile often if working on large contiguous areas of the image.

Blend. The "Blend" tool is used to blend the edges of areas in an image that have been manipulated to reduce the obvious edge created between the moved portion and its new background. This helps windows or moved objects to blend in naturally with the background and to avoid an obvious "cut-and-paste" look. Since much of image editing involves framed moves, tiling, and window operations, the blend tool is used frequently.

Blending is done by selecting "BLND" under the Special Effects group icon. It can be used in conjunction with any of the drawing tools. For example, a filled rectangle could be used to blend a larger area, or freehand drawing could be used to more carefully blend small areas. The sharpness slider sets the degree of blending with each pass. A greater number causes less blending (up to 10) and lower numbers increase blending (to -2). When the continuous bar is highlighted, an area can be blended repeatedly until the desired effect is achieved. When the continuous is off, an area can be blended only once. The blend tool should be used sparingly, since it can easily wash out image details if used excessively.

Resolution-Independent Object-Oriented Software (RIO)

RIO is not used primarily for cut-and-paste operations like TIPS, although RIO has some of these functions. The RIO interface is not icon-driven, and is more complicated and less intuitive than TIPS.

While RIO can import, process, and output TGA files, the basic building block in RIO is called an object. Entities created in RIO, such as text strings, rectangles, circles, etc. are called objects, and are stored separately as OBJ files. Another important RIO building block is the scene. A scene is made up of a collection of OBJ files and is stored as an SCN file. A scene is a record of the placement of objects in an image, as well as the shape, style, and color of each object. A SCN file differs from a TGA file in that it is not simply a record of colors and pixel locations (raster-based); rather it is a reference file that mathematically describes objects, their identities, and their spatial locations (vector-based). Since it does not contain color data for vast numbers of pixels, SCN files are generally very small.

SCN files also differ from TGA files in that they can be modified after being saved. In a raster-based application like TIPS, an object pasted into an image and saved becomes a permanent part of that TGA file. The portion of the original image that was under the pasted object is lost and cannot be recovered. This is not the case with a RIO SCN file. Objects in SCN files, such as text, sketch graphics, or imported TGA files can be moved, rotated or otherwise modified without becoming a permanent part of the file. This means that an SCN file can be changed repeatedly without having to start from scratch each time changes are desired. (Caution: since SCN files do not contain the actual data from any imported TGA files, but refer to the TGA file when the information is needed for rendering an image, any TGA file imported into a scene must not be deleted or moved to a different directory until after the scene has been saved as a TGA file.)

When output is desired from RIO, the SCN file can be written to a TGA format file for inclusion in a Panorama slide show, creating 35mm slides, or for producing color prints.

Effective use of RIO requires using many more tools than are required to use TIPS effectively. Rather than summarize each important tool in RIO, this section describes the general procedure for producing an image in RIO on a step-by-step basis.

Set Page Format. This step is described fully in the Image Input section, which precedes this one.

Set Display. This procedure is also described in the Image Input section.

Set Background. "Background" is located under "Option" on the main menu bar at the top of the screen. This command controls the backdrop on which objects are placed and scenes constructed. Backgrounds can consist of flat colors, gradients of several colors blended together, or an image, such as a TGA file. If an image is selected as the background, it can be cropped beforehand. The background image will conform to the dimensions of the page format, and distortion may occur if the image is a different size. For example, if an image with a spatial resolution of 756x486 was imported as a background into a page format of 512x486, the imported image would be horizontally compressed, causing noticeable distortion.

Create Objects. Most of the work done with RIO consists of creating and modifying objects. Objects can be text strings, lines, rectangles, circles, polygons etc. that can be used to create labels, legends, arrows, maps and other graphic communication aids. An important class of objects are images - TGA files, WIN files, and other graphic format files that can be imported into a scene, regardless of their spatial resolution.

There is an "Attributes" submenu under each individual object menu that is used to specify the characteristics of the object being created, such as color, number of sides, transparency, shadowing, etc. Each of these attributes should be experimented with to determine their visual appearance and possible uses in developing high quality finished simulations. When the attributes are set, press <cancel> to place the object in the scene. Once object attributes have been assigned, a series of objects with the same characteristics can be created by selecting the same object from the "Build" menu.

Edit Objects. Objects in a scene may be moved and manipulated after they have been pasted down by moving the cursor onto the object and selecting it. A rectangular bounding box will appear when an object has been selected. Icons surrounding the box indicate features that can rotate, flip, scale, move, copy, and delete the object. The attributes of an object can be edited or changed after it been created by moving the cursor to the center of the bounding box that surrounds the object and pressing <cancel>. This action brings up the "Attributes" submenu for the object and any desired changes may be made. These changes affect only the individual object that is selected. The procedure for changing a text object is similar, except that the "Edit" icon should be selected at the bottom of the bounding box.

Compose the Scene. Tools used to compose objects in a scene can be found under both the "Edit" and "Select" menus on the main menu bar. Use "Justify" under the "Edit" menu to align selected objects from top to bottom and from left to right in relation to each other or the page. First select the object(s) to be justified, choosing first the object that the others should be justified to. Then, use the "Justify" submenu to select the desired options. If some objects overlap, the Order commands: "Front," "Back," "Push," and "Pull" can be used to reorder them. This is done by selecting the object and then choosing a tool (such as "Back") to move that object behind any others.

Commands may be executed on more than one object at a time by using the tools under the "Select" menu. "Sel all" will automatically select all the objects in a scene. Some of the objects may then be deselected to leave the ones of interest active. These remaining objects could then be combined into one entity using the "Group" command. Grouped objects can be treated as one object. For example, if a title block was created using text and graphics, all of the constituent objects could be grouped together, so that the entire title block could be moved or manipulated as one unit. There are also options for deselecting and ungrouping objects as well.

View and Save the Scene. It is helpful to be able to view the scene as it will appear in final form. Scenes in RIO are drawn in a draft mode during the initial construction of the scene, which can sometimes make it difficult to visualize the final product. The "Render" command under the "Control" menu will redraw the scene at screen resolution to show exactly how it would look if it was printed to a TGA file at screen resolution. If the scene includes a high-resolution TGA file as a background or object, "Render" will redraw the scene at screen resolution to approximate its actual appearance.

The current scene can be saved by selecting "Files" from the "Control" menu. The file types are located on the left side of the submenu, file operations are on the right. Select "Scene" then "Save" and type in a name for the new SCN file. In a similar way, scenes or images can be loaded, deleted, etc.

Print Scene to File. When the scene composition is finished, and the image is ready for output, it should be printed to a TGA file using the "Print to File" command under the "I/O" menu. Printing scenes directly to a Postscript file or device should be avoided, as the Postscript language interpreter in RIO sometimes makes formatting errors. The "Print to File" option can be used to create screen-resolution as well as high-resolution TGA files. Screen-resolution files can be included in Panorama slide shows or in video output. High-resolution files can be sent to a color printer by using the "Print to Device" command under the "I/O" menu, or they can be stored on diskette(s) and sent to a service bureau for slide production.

Print File to Device. Printing a TGA file on the color thermal printer provided with the workstation is a straightforward process. Select the option "Set output device" from the "I/O" menu. The device should be set to Postscript and the setup to Default. Press <cancel> and then choose "Print to Device." Select "Input" from the submenu and choose from the four input types available. Generally, "Image file" would be the most often used to print a TGA file. When the input has been selected, press the "Print to device" button at the bottom of the submenu to execute the print. Printing times may vary considerably according to file size.

Proxy Edit. This is a process by which the user temporarily exits RIO and loads up an editing application such as TIPS to edit an image. When the image editing is done, RIO automatically loads up again, and updates the image file. The most important function of proxy editing is to allow the user to edit high-resolution files in a screen-resolution paint package such as TIPS.

The proxy edit process involves selecting a file for editing, then selecting a screen-resolution sized portion of the image for editing. Select "Proxy" from the "Utility" menu and choose an image to proxy edit by selecting "Image." When the file is loaded, press "Select area" from the submenu. If the image is screen-resolution, then the whole image will automatically be selected. If the image is larger than screen-resolution, then RIO allows a portion of the image to be selected for editing. The program then exits RIO, and launches TIPS. The screen-resolution image may then be edited in TIPS. When editing is finished, the user exits TIPS and RIO is automatically reloaded. RIO asks if the original file should be updated to reflect the edits made in TIPS. RIO then asks the user to select another screen-resolution sized portion of the original image for editing. In this manner, the user "moves" through the high-resolution file, editing screen-sized portions of the image until the whole image has been covered.

Image Output

This section discusses the various output formats commonly used to produce video simulations. Output images can be classified according to the source of the data used to produce the final image. Primary output is produced directly from the electronic image data. An example of primary output is 35mm slides that are film-recorded directly from TGA files. Secondary output is produced using primary output as a data source. Examples of secondary output include prints made from slide enlargements, or photocopies of paper prints produced by a digital printer.

Each type of output is appropriate for particular purposes in the simulation production and presentation process. For example, black and white prints are suitable for obtaining feedback about draft simulations, while 35mm slides are best suited to more formal presentations of finished simulations. Suitability for a particular purpose is primarily determined by inherent qualities of each format such as: size or display equipment requirements; the image quality of each format; and the ease and expense with which finished images can be produced in the format. This section discusses each of the major primary output formats in terms of image quality, convenience and cost of production, strengths and weaknesses for use in simulation, and suitability for various uses. The in-depth examination of primary output formats is followed by a brief discussion of secondary output formats.

Primary Output Formats

Analog RGB Monitor Images. The image displayed on the monitor used to edit the simulation can be used as a presentation format for small groups. Monitor images are particularly effective when used in combination with image-sequencing software, such as Panorama. Panorama can be used to create dynamic "slide shows" that allow simulation viewers to see images of existing landscapes suddenly transformed into finished simulations in seconds (see the discussion "Creating a Slideshow" below). This dynamic transformation from existing to proposed appearance is very effective for communicating specific visual impacts, and cannot be duplicated by static formats such as slides.

The graphic quality of RGB analog monitor images is usually very good: spatial resolution is good, while color fidelity to the original image is limited only by the quality of the scanned or video-captured image from which the simulation was derived. The spatial resolution is limited to the screen resolution of the monitor, and so is not as good as can be achieved with 35mm slides or high-quality digital prints.

Monitor images are produced as part of the editing process, and as such, require no additional steps for output, and therefore incur no extra cost to produce. If they are part of an electronic slide show, then some sort of "script" must be prepared for the show, but the time cost per simulation is usually quite low.

RGB analog monitor images are high quality and very low cost. They are easy to produce, and have dynamic presentation capabilities that are highly effective for communicating impacts. On the other hand, RGB analog monitor images require a computer to be displayed, and so are impractical in many presentation situations. The relatively small display size limits the number of persons that can effectively view the simulation at any one time. The electronic format of the monitor images means they are usually displayed briefly, and cannot be easily annotated or otherwise marked up to reflect feedback. They also cannot achieve the spatial resolution of 35mm slides or high quality prints.

The dynamic quality of "electronic slide shows," combined with the relatively high quality of monitor images, makes it desirable to use monitor images as a presentation format whenever the situation and audience size permit. However, in general, monitor images are best used in conjunction with other output formats that are more permanent in nature, such as prints. Monitor images are most effective in small group presentations, where the entire audience can comfortably view the image.

Film-Recorded 35mm Slides. Simulations can be produced as high-quality 35mm slides through the use of a film-recorder, a device which essentially shoots a picture of the image that is displayed on a small cathode ray tube. Proper use of a high-quality film recorder results in very sharp, true-to-color slides.

35mm slides can achieve very high spatial resolution as well as excellent color fidelity. In most situations, slides are the best quality images that simulation preparers will be able to produce. Achieving this high image quality requires high-resolution source images (i.e., greater than screen-resolution) to begin with, and also will generally require that the source files be sent to a service bureau for film recording on a high-end commercial film printer. Low end film printers ($5000 to $15,000), while still able to produce good quality images, cannot match the quality of commercial film printers that may cost over $100,000.

If an image is to be produced as a slide by a service bureau, it must be written out to a floppy diskette or a data cartridge, such as a Bernoulli cartridge. The cartridge or diskette must then be shipped or otherwise transported to the service bureau. Most service bureaus can produce a slide in 1 to 2 days, so that total turnaround time is usually 2 to 5 days. Rush service is often available. High-quality slides can usually be film-recorded for $5 to $10 per slide. Additional copies usually are less than the first slide, but are equal in quality.

Slides are an excellent format for presenting simulations for several reasons: image quality is excellent, image size can be tailored to fit audience needs, and no computer equipment is required for display. Slides can also be used as a source for secondary output formats. For most simulation preparers, slides will be the format of choice when image quality is critical. However, slides usually require several days of processing, and for large numbers of simulations, can be very expensive. They also cannot be marked up or otherwise annotated to reflect feedback.

Slides are well suited to presentations of finished simulations to both large and small audiences, particularly if high image quality is a concern. As with monitor images, slides are best used in combination with other, more permanent output types, such as prints.

35mm Slides or Photographic Prints from Screen Images. Thirty-five millimeter slides or prints can be shot directly from the monitor screen. For best results, the procedure must be done in a fully darkened room, with care being taken to align the camera lens perpendicular to the face of the monitor. Exposure times should be in the range of 1/4 second to ensure that a complete scan of the monitor image is captured. A tripod and cable release should be used.

Image quality for slides or prints shot-off-screen ranges from poor to good, depending on the care taken in making the pictures. The image quality is far poorer than can be achieved through quality film recording.

The procedure for taking quality pictures off-screen is laborious, and requires film purchase and processing. Cost per image is relatively high because of the labor involved.

Shooting slides or prints off-screen should only be done when time or budget will not allow film printing. The relatively poor image quality does not justify the labor expense involved in preparing the images.

Photographic Prints. The process for producing photographic prints from simulation files is identical to that used to produce slides, except that print film is substituted for slide film in the film recorder. The negatives can then be enlarged to the desired size.

Photographic prints can achieve very good quality both in terms of spatial resolution and color fidelity. If properly produced, a clean, sharp image should be produced, though loss of sharpness necessarily occurs when the negative is excessively enlarged. Color fidelity is generally somewhat less than with slides, though usually still very good.

Prints require the same processing and turn-around time as slides if a service bureau is used. However, cost for enlargements can cause prints to be more expensive to produce than slides, generally in the range of $10 to $50 depending on the size of the enlargement. Cibachromes, special prints with fade-resistant dyes, may cost more, but are suitable for archival purposes.

Photographic prints offer high image quality, durability, permanence, and can be marked up to reflect feedback, although the cost per image may prohibit marking images. They can be expensive to produce, however, and take several days to process.

Photographic prints are useful for presenting final simulations to small groups (or larger groups if poster-size enlargements are made). They are also useful for long term storage of simulation images.

Paper Prints and Overhead Transparencies. The term paper prints here refers to nonphotographic prints produced by printing devices connected directly to a microcomputer, including thermal transfer printers, ink jet printers, laser printers, dye sublimation transfer printers, etc. These prints are usually produced in-house rather than being sent to a service bureau.

Spatial and color resolution of paper prints varies from good to poor depending on the printing device used. Paper prints do not approach the quality of photographic prints or slides. Dye sublimation transfer prints are usually of better quality than thermal transfer prints, which are better than ink jet prints.

Prints produced in-house offer convenience and low cost. While high-resolution images may take an hour to print, most images take far less time. Prints usually cost for $0.50 to $2.00 per sheet to produce, though numerous sheets may be wasted trying to correct colors in the printed image. Some printers are sensitive to dust and must be cleaned frequently.

Paper prints are cheap and easy to produce. They can easily be marked up to show proposed changes to the image, and thus can be very useful for obtaining feedback. However, most paper prints are easily damaged and often fade relatively quickly. The small formats available on most in-house printers restrict the number of people that can view an image at a given time.

The relatively low image quality of paper prints makes them generally poorly suited for final presentations. They are well-suited to presenting draft simulations for comment, and feedback can be marked directly on the print. The relatively low unit cost makes paper prints suitable for mass distribution, e.g., in mailings or as handouts at meetings. Their lack of durability and tendency to fade makes them poorly suited to archival uses. Overhead transparencies are suitable for small, informal presentations, but are often very fragile and easily scratched.

Video. Simulations can be assembled into an "electronic slide show" using an image sequencing software package such as Panorama (see "Creating a Slideshow" below). The slide show can then be recorded onto videotape using the composite video out capabilities of the TARGA+ video graphics adapter. Narration can be dubbed onto the videotape afterward.

Video suffers from low spatial resolution and poor color fidelity, as well as a tendency for colors to "bleed" off objects onto the surrounding background. Video is one of the poorest output formats in terms of image quality.

Images that are supposed to be recorded on videotape must be at a spatial resolution that the TARGA+ board can output to video. The necessary resolutions are generally below standard screen resolution, so that images may have to be reformatted. Composing a script in Panorama or other sequencing software and recording onto videotape is relatively easy. Cost per image is negligible.

Videotape presentations are dynamic, and can be narrated, so that they allow the creation of a "canned" presentation that can be viewed on any standard VCR and monitor. Videotape presentations are easy to make in-house, although synchronizing narration to the images for a long presentation can be an involved process. However, the poor image quality of the video format is a serious use limitation.

Videotape simulation presentations are useful for presentations to small groups, where monitor image presentations are not feasible. When possible, videotape presentations should be combined with another output format of higher image quality, such as photographic prints, particularly for final presentations. Videotape simulations presentations can be very useful for presenting draft simulations (if combined with some markable format, such as paper prints), and are also useful for "canned" presentations when the simulation preparer cannot be present.

Secondary Output Formats

Slide Enlargements. Thirty-five millimeter slides can be enlarged to make prints of varying sizes. Image quality can be quite good, although some sharpness can be lost in the enlargement process, and images are often darkened slightly.

Color Photocopies. If copied by a skilled operator on properly calibrated equipment, color photocopies of photographic or paper prints can achieve nearly the same graphic quality as the original. Color photocopies can be useful for low-cost replication of these formats. Color photocopies of slides are usually of poorer quality because the slides must be projected onto a glass surface, resulting in loss of sharpness and image darkening.

Black and White Photocopies. Black and white photocopies are usually of very poor graphic quality, but may be adequate for providing a copy of a draft simulation for marking and annotating.

Facsimiles (Faxes). Currently available software and hardware allows images or text to be faxed directly from a computer to a FAX machine. This method of faxing avoids much of the image quality degradation that occurs during the scanning process of normal faxing. Of course, all color information is lost, but the faxed image may be suitable for sending to remote sites to obtain feedback.

Creating a Slideshow

The Panorama software package from AT&T Graphics Software Laboratory allows the user to create "slide shows" of TGA images. Panorama is technically referred to as image sequencing software, because it can automatically display a sequence of images in a predetermined order, without requiring the user to enter commands to display each image. The choice of displayed images, image sequence, and the time duration of each image is determined by a script written by the user prior to running the show. The slide show can be played back on the RGB analog monitor that is normally used to display the images, or it can be recorded to videotape using the "video out" capabilities of the TARGA+ graphics adapter.

Panorama is an important tool for producing finished simulation products, because it allows dynamic presentation of simulation sequences, where the "existing" image changes to the "simulated" image on-screen in seconds. The dynamic change from existing to simulated image highlights the proposed change to the existing landscape in a very dramatic way that cannot be matched by static formats such as slides or prints. Another benefit is the convenience of having Panorama display a show essentially unattended—the user simply launches the slide show, and is then free to discuss the images as they are displayed, without distractions. The presenter can temporarily stop the show and focus on a particular image, or replay a portion of the show, with a few simple keystrokes, without distracting the viewers from the presentation.

The tradeoff for the dynamic format and convenience of Panorama is in image quality; the program is limited to displaying screen-resolution images, so that image quality is not as good as with high-resolution output formats, such as slides or prints. Because of this limitation, Panorama slide shows are usually presented along with slides or prints, rather than standing alone as the final simulation product.

The Panorama package is relatively simple to learn to operate. The interface differs significantly from that of RIO or TIPS in that it does not use icons to represent commands. It is operated using a mouse, tablet, or the keyboard arrow and letter keys (to select text-format commands listed in pull-down menus). Furthermore, the command interface is located on the VGA monitor (the system monitor), instead of the RGB analog monitor used to display images when the slide show is running, and to load individual images for reference purposes when creating or editing a slide show. Relatively few commands are required to create and run basic slide shows, and the essentials can be mastered in a few hours. Step-by-step summaries on creating, editing, and running a slide show using Panorama follow.

The Show Menu

Almost all the important commands in Panorama are found under the Show menu. The Show commands allow the user to create, save, edit, and run slide shows. The first step is to select "New Show" to create a new script or "Open Show" to work with an existing script. The two most important show commands are "Run Show" and "Edit Show."

Run Show

Selecting "Run Show" displays (plays) the current slide show on the analog monitor. All or part of the show may be played, at the discretion of the user.

Edit Show

"Edit Show" allows slide shows to be created and edited. After selecting Edit Show, the script for the current show is displayed in tabular format on the VGA monitor. Pressing the Insert key on the keyboard causes a submenu to appear, prompting the user to specify an action.

An action can be one of 24 commands that range from inserting new images into the slide show to building animation sequences. The action that will be specified most frequently is "Image" (i.e., insert an image into the slide show).

Selecting Image causes a pop-up menu to appear that prompts the user to specify an image to be added to the show, its duration, the transition effect that will occur as this image is loaded, and the speed of the transition. Many transition effects are available, including Fade to Image, a striking effect that causes one image to fade directly into the next image. Fade to Image and Vertical Wipe are useful for showing the transition between base images and simulation images.

Saving a Slide Show

After building a slide show, the show is saved to disk, but can easily be modified later if desired. The resulting slide show can either be played on the RGB analog monitor, which will give the best quality images possible for the show, or be converted by the TARGA+ into an NTSC composite video signal and recorded to videotape. The video format is obviously more convenient, but results in significant loss of image quality.

"Save" and "Save As" are options in the Show pull-down menu. Save As is used to save the show under a different file name. The saved show has a filename in the following format: *filename*.sho. Remember that this file consists of the slide show script only, not the actual image files. The data in the script file is actually a set of instructions to load the image files for the specified duration, with the specified transition, etc., and requires that the image files remain in the directory indicated in the script. If, after making the show file, the user deletes the actual image files from the hard drive, or moves the image files to a new directory, errors will occur when the show is run because Panorama cannot locate the specified files. For this reason, the user may wish to store all image files that will be used in Panorama shows in a single directory, and leave them in that directory, so that they are always available to Panorama.

Other Capabilities of Panorama

In addition to the basic slide show creation, editing, and display process, Panorama has many other capabilities, including the ability to create limited two-dimensional animation sequences (such as moving a logo across the screen) and the ability to mix still graphics with live or recorded videotape. Shows can also have pre-set pauses, stand-by options, interactive shows, and a variety of other effects. One can load individual images for reference purposes using the "Image" submenu. (Consult the Panorama documentation for instructions on operating these advanced features.) Note that the Panorama documentation contains an excellent tutorial that takes the user step-by-step through the most important features of the program, including the process described above.

7 SUMMARY AND RECOMMENDATIONS

Video simulation technology offers land managers the opportunity to simulate the appearance of proposed projects realistically and inexpensively before they have been built. Since the video medium offers a format that is familiar to both trainers and the public, it can provide a convenient, reliable method for obtaining trainer input, thereby helping to make more realistic training environments likely. Pilot projects at Camp Shelby, MS and Fort Sill, OK have shown video simulation to be a versatile tool for disseminating public information and motivating involvement in training land design. Simulations prepared for use in public hearings for the Camp Shelby environmental impact statement, helped planners and decisionmakers clearly communicate the proposed project and its impacts. The positive response of land managers and other audiences to the simulations suggests that video simulation can be a useful tool for Army training land managers and trainers.

It is recommended that the Army Major Commands and various installations continue to follow the ITAM Implementation Plan for video simulation. The three-phase implementation approach developed for video simulation allows installations to intelligently evaluate the various applications and determine whether it would be cost effective to implement.

This work was undertaken to fill the need for a "how-to" instructional and reference manual to help Army land managers and trainers better apply video simulation technology to land management activities. This report is a composite of information gathered from demonstrations at a number of Army installations. It is recommended that installations not presently using video simulation as a land management tool consider the general, technical, and conceptual information contained in this report, and the market study of currently available hardware and software in formulating a video simulation plan suitable for their particular applications.

APPENDIX A: Video Simulation Implementation Approach

The first phase in implementing a video simulation program is to initiate test applications of videographic technology for land management projects at installations, i.e., a new range requirements and/or rehabilitation action. Approximately 10 to 15 images would be prepared for a project. This will demonstrate the technology and acquaint installation personnel with these state-of-the-art capabilities. In coordination with installation land management personnel, USACERL will evaluate the results of the test applications. Applications will be assessed for quality of display of the finished project, appropriateness in describing and marketing the requirements for the project, and utility in use as tools for project construction. Evaluation will also address the time/dollar requirements for the simulation efforts and both subjective and objective costs and benefits.

Based on the evaluation in phase I, the specifications and configuration for a video imaging workstation would be developed as a guide for fielding the technology itself at the installation. Installation personnel would decide, based upon the evaluation in Phase I, whether the cost/benefit justifies installation of a workstation. Phase II, then, would be to field the imaging workstation, and to provide training support.

Phase III consists of continued support to the installation, and updating the technology in this rapidly changing field. The update would include training, as required, and provide an opportunity to conduct video simulation for special project areas on the installation. It also provides USACERL personnel the critically needed feedback to further refine and develop the technology for land management purposes.

APPENDIX B: Enhancing GRASS Images With Videographics Technology

Introduction

Images created by the Geographic Resources Analysis and Support System (GRASS) software can be converted into the TGA format used by the videographic workstation. Converting GRASS images into a TGA format allows the user to alter the content of GRASS images, add labeling or sketch graphics, combine GRASS images with scanned photographic images, and print GRASS images to 35mm slides, hardcopy prints or videotape. This appendix describes the basic procedures to import GRASS images into a TGA format. It is assumed that the user has a basic familiarity with both GRASS Version 4.0 and the TARGA+ videographics system.

Procedure

Importation of GRASS images to the TGA format is done by using the GRASS raster command ***r.out.tga.*** This interactive command converts a specified GRASS raster image into the TGA raster format used by the videographic hardware and software. The user simply types r.out.tga at the GRASS command prompt, and will then be prompted to supply a name for the raster file to be converted to TGA format, and a name for the newly created TGA file. Although further manipulation of the file is necessary, it must be sent to the DOS-based videographics workstation by some method, usually over a network file transfer system.

Constraints

Only raster GRASS images can be converted to TGA format. GRASS vector files and three-dimensional view images and screen dumps cannot be exported to TGA format using ***r.out.tga***. All spatial and attribute data contained in the original GRASS layer is lost; once the image is in TGA format, it becomes a simple raster image file.

Hints and Suggestions

GRASS vector files such as roads and hydrography can be converted into raster format and then converted into TGA format by r.out.tga. There will be loss of resolution and line quality during the vector to raster conversion, however.

GRASS data cells are converted to TGA pixels on a one-to-one basis, that is, each grid cell in a GRASS raster image becomes one pixel in the TGA image. Thus, if the user desires the entire GRASS image to be displayed on the screen in TGA format, the user may have to adjust the cell size (resolution) of the GRASS image so that it corresponds to the desired resolution of the TGA file.

The aspect ratio of GRASS images does not necessarily correspond to the aspect ratio of the TGA screen display. If the user desires the TGA image to appear on the screen with no spatial distortion, the aspect ratio must match that of the GRASS image, which is itself dependent on the relative dimensions of the GRASS data cells. If the Targa+ display ratios are not 1:1 (square pixels), it is possible to adjust GRASS cell sizes to match Targa+ displays. However, matters are simplified greatly if 1:1 aspect ratios are specified for both the initial GRASS raster image cell size and the Targa+ display resolution.

All files exported from GRASS to a DOS-based platform must conform to DOS file-naming standards, and should end with a .tga extension. Without a .tga extension, the file will not be recognized by videographics software applications, and will need to be renamed.

APPENDIX C: Basic Photography

Camera Controls

The basics of camera operation are relatively straightforward once a few controls and te chniques are understood. This section will discuss the basic controls of a manual SLR (single lens reflex) camera. SLR refers to the focusing system of this type of camera. The image seen through the viewfinder is the exact image that will be photographed when the shutter release is pressed. This system greatly simplifies framing the subject and of getting accurate light meter readings. Controls that adjust the amount of incoming light and length of exposure for a picture are important, not only in the way they affect a picture's quality individually, but in how they interact. The photographer should thoroughly understand how both the aperture and shutter work to operate them effectively and achieve high-quality results.

Aperture

The aperture controls the amount of light admitted to the film's surface (and the viewfinder as well). Varying the aperture can make the image lighter or darker and can also increase or reduce the "depth of field"—the zone of sharp focus in front of and behind the focused subject. The lens aperture consists of a diaphragm made of overlapping leaves that form a roughly circular opening in the center. This can be set to a variety of diameters to allow more or less light in. When photographing a dimly lit subject, a wide aperture is used to allow more light to expose the film. Conversely, bright subjects require a small aperture setting. The aperture control ring has settings that progressively double (or half) the amount of admitted light. Each of these settings is given an "f number" (or f-stop). This number refers to the ratio of the diameter of the aperture to the focal length of the lens (this will be discussed below). The ratio is used to standardize f-stop settings between lenses. For example, any camera lens set to the same f-stop will photograph the same subject at the same level of brightness. This consistency can be important if a zoom lens (a lens with variable focal lengths) is used. The important thing to remember is that low f stops (f2.8 or f4) let in more light and high f stops (f22 or f16) let in less light.

Focal Length

Focal length refers to the distance in the camera between the lens and the film when the focus is set to infinity. Longer focal lengths make distant objects appear larger and narrows the angle of view. Lenses with a short focal length widen the angle of view, allowing more into the picture. A 50mm lens approximates the normal field of vision of the unaided human eye. Most of the photography for simulation work is done with a 50mm lens. However, it may be useful to have a "zoom lens" for special situations. A "zoom lens" is a lens with a complicated optical arrangement that allows the photographer to change the focal length of the lens. An appropriate zoom lens for base image photography would be one with a range of 28 to 85mm.

Shutter

The shutter also controls the amount of light admitted into the camera by the length of time that the shutter remains open. The shutter speed dial is generally located on top on the camera body near the shutter release button. Shutter speed settings, like f numbers, progressively decrease; each setting is half the exposure time of the previous one. Shutter settings are identified by the length of time that they keep the shutter open, usually measured in fractions of a second (e.g., 1/500, 1/250, 1/125, etc.). Faster shutter speeds tend to "freeze" any movement in the image, where slower speeds may allow elements to blur. For this reason a tripod is recommended for fieldwork, especially under lower light conditions.

Techniques

It is obvious that many different photographic effects can be achieved with various combinations of the above controls and settings. However, for the purposes of this section only those dealing with taking high-quality landscape photos for the purpose of creating video simulations will be addressed. The goal is to take pictures that are in focus, properly exposed, and that have the maximum possible depth of field. Other issues, such as bracketing exposures, are covered in Chapter 6 under **Image Capture** (p 28).

Focus is extremely important considering that blurred areas may be enhanced through the scanning process. The primary subject of importance in the photo should be used to focus. Increasing the depth of field also increases the level of focus that objects in front of and behind the primary subject appear to have. Increasing the shutter speed can also decrease blur in the image.

Balancing all of these settings to get a nicely exposed picture can be challenging. There are always tradeoffs to be made. The need to allow sufficient light in to expose the film by increasing the aperture and decreasing the shutter speed is offset by the desire to have a maximum depth of field by doing just the opposite. Exposures should strive to set the f-stop and the shutter speed as high as possible, while maintaining an adequate amount of light for a usable picture. This will assure exposures that are crisp and have good depth of field. The light meter in the camera should indicate the level of light at each of the different setting combinations. Exposures should always be bracketed. It never hurts to take many more exposures than may seem necessary at the time. In this way, at least one good exposure of each scene is inevitable.

Film Types

Film is differentiated by type, brand, size, and speed. The type of film to be used for video simulations is color slide film. The scanner generally used with the video simulation workstation requires 35mm slides for scanned input. Print film can be used if the simulation workstation is equipped with a flatbed scanner that can scan color hardcopy. The name of slide film will usually end with "...chrome," such as "Fujichrome" or "Ektachrome." Either one of these film brands will provide good color rendition and image clarity. The processing time for a film like Kodak Ektachrome can be as short as 2 hours. Film size is 35mm and comes in rolls of either 24 or 36 exposures. The last important aspect concerning film selection is sensitivity or "speed," which is given by its American Standards Association (ASA) rating. Film for normal outdoor use is rated as 100 ASA. Film rated at 400 ASA is four times as sensitive to light and so is used in lower light conditions. The faster the film, the less exposure is needed, but the "grainier" the picture will be. At an ASA of 400 and lower this is generally not a problem. For slides destined for simulation work, a combination of film speeds should be taken to the field. In this way shooting can continue even if it becomes cloudy, or if slides are required in shaded areas. Use 200 ASA for general purpose photography and 400 ASA for low-light conditions.

APPENDIX D: Field Checklist and Data Collection Forms

For General Purpose Simulation Work:

_____ 35mm single lens reflex (SLR) camera, with a 28mm-85mm zoom lens, polarizing filter, and lens cap

_____ Sturdy, portable tripod

_____ Padded camera bag to protect equipment and store film

_____ Several rolls of assorted color slide film (100, 200, 400 ASA)

_____ Copies of "Photography Field Notes," Clipboard, and pencils

For Dimensionally-Accurate Simulation Work: The above plus the following:

_____ 100-ft metal tape or chain

_____ 2-4 stadia rods or other markers

_____ Twine and brightly-colored cloth pieces

Optional:

_____ Transit or theodolite

_____ GPS receivers

VIDEO SIMULATION: PHOTOGRAPHY FIELD NOTES

SITE: **DATE:**

FILMROLL: **ASA:** **WEATHER:**

#	Location	FL	Shutter	f stop	Comments

DISTRIBUTION

Chief of Engineers
ATTN: CEHEC-IM-LH (2)
ATTN: CEHEC-IM-LP (2)
ATTN: CERD-L

CEHSC
ATTN: CEHSC-F 22060
ATTN: CEHSC-TT 22060
ATTN: CEHSC-ZC 22060
ATTN: DET III 79906
ATTN: CEHSC-FM (4) 22060

US Army Engr District
ATTN: Library (40)

US Army Engr Division
ATTN: Library (13)

US Army Europe
ATTN: AEAEN-EH 09014
ATTN: AEAEN-ODCS 09014
V Corps
ATTN: DEH (8)
VII Corps
ATTN: DEH (11)
29th Area Support Group
ATTN: AERAS-FA 09054
100th Support Group
ATTN: AETT-EN-DEH 09114
222d Base Battalion
ATTN: AETV-BHR-E 09034
235th Base Support Battalion
ATTN: Unit 28614 Ansbach 09177
293d Base Support Battalion
ATTN: AEUSG-MA-AST-WO-E 09086
409th Support Battalion (Base)
ATTN: AETTG-DEH 09114
412th Base Support Battalion 09630
ATTN: Unit 31401
Frankfurt Base Support Battalion
ATTN: Unit 25727 09242
CMTC Hohenfels 09173
ATTN: AETTH-DEH
Mainz Germany 09185
ATTN: BSB-MZ-E
21st Support Command
ATTN: DEH (10)
US Army Berlin
ATTN: AEBA-EH 09235
ATTN: AEBA-EN 09235
SETAF
ATTN: AESE-EN-D 09613
ATTN: AESE-EN 09630
Supreme Allied Command
ATTN: ACSGEB 09703
ATTN: SHIHB/ENGR 09705

INSCOM
ATTN: IALOG-I 22060
ATTN: IAV-DEH 22186

USA TACOM 48397
ATTN: AMSTA-XE

Defense Distribution Region East
ATTN: DDRE-WI 17070

HQ XVIII Airborne Corps 28307
ATTN: AFZA-DEH-EE

4th Infantry Div (MECH)
ATTN: AFZC-FE 80913

Fort Pickett 23824
ATTN: AFZA-FP-E

Tobyhanna Army Depot 18466
ATTN: SDSTO-EH

US Army Materiel Command (AMC)
Redstone Arsenal 35809
ATTN: DESMI-KLF
Jefferson Proving Ground 47250
ATTN: STEJP-LD-F/DEH
Letterkenny Army Depot
ATTN: SDSLE-ENN 17201

Pueblo Army Depot 81008
ATTN: SDSTE-PUI-F
Dugway Proving Ground 84022
ATTN: STEDP-EN
Tooele Army Depot 84074
ATTN: SDSTE-ELF
Yuma Proving Ground 85365
ATTN: STEYP-EH-E
Tobyhanna Army Depot 18466
ATTN: SDSTO-EH
Seneca Army Depot 14541
ATTN: SDSSE-HE
Aberdeen Proving Ground
ATTN: STEAP-DEH 21005
Sharpe Army Depot 95331
ATTN: SDSSH-E
Fort Monmouth 07703
ATTN: SELFM-EH-E
Savanna Army Depot 61074
ATTN: SDSLE-VAE
Rock Island Arsenal
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6th Infantry Division (Light)
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Tyndall AFB 32403
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USA TSARCOM 63120
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American Public Works Assoc. 60637

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